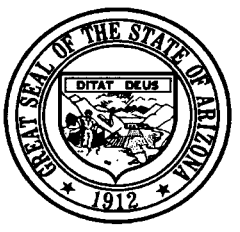
CHAPTER

# 7

# *Groundwater Quality Management Program*



## 7.1 INTRODUCTION

Water quality is a vital component in the management of the Phoenix Active Management Area's (AMA) water supply. The Arizona Department of Water Resources' (Department) role in water quality relates to the impacts of water quality on available water supplies. Protecting and managing water quality maximizes the overall quantity of usable water, and matching the best use to the quality of water is a significant aspect of meeting the Department's water management objectives. This chapter defines the Department's role and authority in meeting groundwater quality management objectives during the third management period and addresses water quality impacts on the management of water supplies in the Phoenix AMA.

Generally, the Department's responsibilities include enhancement of groundwater quality protection programs, assistance in the clean up of contaminated areas, and assistance in matching water quality with the highest beneficial use. In the third management period, the Department will play a greater role in water quality issues because of increased responsibilities and funding for water quality management activities provided for in the 1997 Water Quality Assurance Revolving Fund (WQARF) Program reform legislation. Laws 1997, Ch. 287. Furthermore, the utilization of renewable supplies such as Central Arizona Project (CAP) water and treated effluent as well as the designation of end uses for remediated groundwater will play a larger role in water supply activities during the third management period.

In general, groundwater in the Phoenix AMA is of acceptable quality for most uses. Most of the groundwater supplies in the Phoenix AMA meet federal and state drinking water standards, though contaminant levels exceed primary safe drinking water standards in a few areas. Groundwater withdrawals from wells within these identified areas have been discontinued or are in the process of being cleaned up through remedial activities. Other areas of known contamination which are not being remediated are monitored to ensure that contaminants do not spread and adversely impact groundwater quality.

## 7.2 GOALS AND OBJECTIVES

The Department's goals and objectives for groundwater quality management for the third management period are complicated due to the Department's dual responsibilities to achieve reductions in withdrawals of groundwater, and to facilitate remediation of contaminated groundwater by implementing incentives for the use of remediated groundwater. The WQARF reform legislation of 1997 creates several incentives for the use of remediated groundwater. In response to the fact that many sites with groundwater contamination have not been cleaned up, the Legislature mandated incentives for remediated groundwater use which could result in a significant increase in groundwater withdrawals. These incentives to use remediated groundwater present a unique groundwater management problem because they may be in conflict with an underlying objective of the Groundwater Code (Code), which is to "achieve reductions in withdrawals of groundwater" to attain the management goal of each AMA.

The Department recognizes that the goal of remediating contaminated groundwater is an important one and intends to facilitate such remediation by implementing incentives for remediated groundwater use. However, as the agency entrusted with the responsibility of managing and conserving Arizona's long-term water supplies, the Department also has the responsibility to ensure that the minimum amount of groundwater necessary to achieve remedial action objectives is pumped and to ensure that where practicable new groundwater uses are not created and groundwater supplies are conserved. While the Department believes that it is possible to both achieve reductions in withdrawals of groundwater and provide incentives for the use of remediated groundwater, it recognizes that there is a delicate balance between the two responsibilities which will involve coordinated efforts between Arizona Department of Environmental Quality (ADEQ) and the Department to ensure that, on a case-by-case basis, no more groundwater is withdrawn than is necessary.

To implement its groundwater quality management challenge, the Department will "coordinate and confer" with ADEQ regarding "water plans, water resource planning, water management, wells, water rights and permits, and other appropriate provisions of [title 45] pertaining to remedial investigations, feasibility studies, site prioritization, selection of remedies and implementation of the [WQARF] program pursuant to title 49, chapter 2, article 5." A.R.S. § 45-105(B)(4)(c). To this end, the Department is in the process of creating a draft Memorandum of Understanding between the two agencies.

The Department's goals and objectives for groundwater quality management for the third management period are the following:

- to ensure that remediation of contaminated groundwater uses the minimal amount of groundwater necessary to facilitate the objectives of each remedial action project.

- to ensure that end uses of remediated groundwater minimize groundwater withdrawals and are consistent with the safe-yield goal.

- to ensure that water quality considerations affecting Department programs that extend beyond the scope of the WQARF program are also addressed in order to preserve groundwater quality and quantity. Some of these considerations include well construction and abandonment standards, well spacing, assured water supply, recharge, and groundwater withdrawal permits.

Pursuant to the WQARF Program, the Department will respond to the highest ranked sites on the WQARF site registry. The Department's objectives are to ensure that remedial action projects are not an impediment to achieving the management goals for each AMA, and that cleanups are performed in a prudent and efficient manner from a water management perspective.

## 7.3 STATUTORY PROVISIONS

ADEQ is the agency primarily responsible for regulating water quality. The Department also has some limited responsibilities in this area. Statutory provisions pertaining to the Department's limited authority to regulate groundwater quality are discussed below.

The Code grants the Department authority to regulate groundwater. Under the Code, the Department has the following authority and responsibilities relating to water quality:

- "[T]he director may ... [f]ormulate plans and develop programs for the practical and economical development, management, conservation and use of surface water, groundwater and the watersheds in this state, including the management of water quantity and quality." A.R.S. § 45-105(A)(1).

- "[T]he director may ... [c]onduct feasibility studies and remedial investigations relating to groundwater quality and enter into contracts and cooperative agreements under § 104 of the comprehensive environmental response, compensation, and liability act [CERCLA] of 1980 (P.L. 96-510) to conduct such studies and investigations." A.R.S. § 45-105(A)(16).

- For the third management period, the director "shall, in cooperation with the department of environmental quality, include in each [management] plan an assessment of groundwater quality in the active management area and any proposed program for groundwater quality protection. Any such program shall be submitted to the Legislature for any necessary enabling legislation or coordination with existing programs of the department of environmental quality." A.R.S. § 45-566(A)(7).

- "[T]he director shall consult with the department of environmental quality on water quality considerations in developing and implementing management plans under this article." A.R.S.§ 45-573.

The WQARF legislation, as revised in 1997, expands the Department's role in water quality management. The Department's responsibilities and authority under WQARF, which will be explained in greater detail later in this chapter, include the following:

- "[T]he director of water resources, in consultation with the director of environmental quality, may inspect wells for vertical cross-contamination of groundwater by hazardous substances and may take appropriate remedial actions to prevent or mitigate the cross-contamination ...." A.R.S. § 45-605(A).

- "[T]he director [of water resources] shall notify an applicant for a permit or a person who files a notice of intent to drill a new or replacement well if the location of the proposed well is within a subbasin where there is a site [with existing or future groundwater contamination presenting a risk of vertical cross-contamination by the well]." The director is also required to adopt rules relating to vertical cross-contamination and new or replacement wells. A.R.S. § 45-605(E).

- "[T]he director of environmental quality and the director of water resources shall coordinate their efforts to expedite remedial actions, including obtaining information pertinent to site investigations, remedial investigations, site management and beneficial use of remediated water." A.R.S. § 49-290.01(C).

- The director of water resources may waive permits, approvals or authorizations if they "unreasonably limit the completion of a remedial action." A.R.S. § 49-290.01(A). The director of water resources may also waive any regulatory requirement under title 45 if the requirement conflicts with the selected remedy in a remedial action as long as the waiver does not "result in adverse impacts to other land and water users." A.R.S. § 49-290.01(D).

- "The department of water resources shall include in its management plans ...provisions to encourage the beneficial use of groundwater that is withdrawn pursuant to approved remedial action projects ...." Laws 1997, Ch. 287, § 51. In order to encourage the beneficial use of remediated groundwater, "the department of water resources shall account for groundwater withdrawn pursuant to approved remedial action projects under CERCLA or title 49, Arizona Revised Statutes, consistent with the accounting for surface water" for purposes of determining compliance with management plan conservation requirements. Laws 1997, Ch. 287, § 51(B).

- "For each calendar year until 2025, the use of up to an aggregate of sixty-five thousand acre-feet of groundwater withdrawn within all active management areas pursuant to approved remedial action projects under CERCLA or title 49, Arizona Revised Statutes, shall be considered consistent with the management goal of the active management area as prescribed in section 45-576, subsection I, paragraph 2, Arizona Revised Statutes." Additionally, in the third management period, 50 percent of the total volume of groundwater withdrawn pursuant to remedial action projects and in excess of the aggregate volume of 65,000 acre-feet shall be considered consistent with the management goal of the AMA. Laws 1997, Ch. 287, § 52.

- "The department of environmental quality and the department of water resources shall develop a method of sharing data, including cooperative data base development and integration between the departments, that will provide the departments with the information necessary to protect the resources of the state." Laws 1997, Ch. 287, § 53.

- "The directors of environmental quality and water resources shall enter into an agreement to coordinate the well inspection and remediation programs and to rank wells within an area of contamination according to each well's potential to act as a conduit to spread contamination and to determine the appropriate remedial action regarding the wells with a potential to act as a conduit, including well reconstruction, well abandonment or no action." Laws 1997, Ch. 287, § 54.

## 7.4 THE REGULATION OF GROUNDWATER QUALITY IN ARIZONA

To understand the Department's role in regulating groundwater quality, it is important to understand the broad framework of laws and programs impacting both groundwater and surface water quality. Since groundwater quantity and quality issues are so interrelated, ADEQ and the Department work together to prevent and mitigate groundwater quality and quantity problems. ADEQ has the lead role in protecting the state's groundwater and surface water quality, while the Department secondarily manages groundwater quality concerns. This section will discuss the regulatory agencies responsible for administering laws impacting groundwater and surface water quality as well as the federal laws and state programs impacting groundwater quality and secondarily surface water quality.

### 7.4.1 Water Quality Regulatory Agencies

Water quality protection programs in Arizona are based on both federal and state law and are primarily administered by either ADEQ or the U.S. Environmental Protection Agency (EPA) Region IX. ADEQ has the responsibility to administer state water quality programs pursuant to state statutes and to administer federal water quality programs for which the EPA has delegated its authority to the state, sometimes referred to as state primacy. EPA has the responsibility to administer federal water quality programs pursuant to federal statutes but delegates its authority to states where the state demonstrates that it can adequately administer the program and the federal statute provides for the delegation of authority to states.

ADEQ has authority pursuant to the Environmental Quality Act (EQA) of 1986 (A.R.S. § 49-101, *et seq.*) to set water quality standards and to regulate discharges that have the potential to impact the quality of groundwater by requiring that discharges are subject to aquifer protection permits (APP). ADEQ has authority under the Clean Water Act (CWA) to set Arizona's surface water quality standards and to certify that discharges subject to federal permits do not violate state water quality standards.

EPA Region IX retains authority to administer the CWA National Pollutant Discharge Elimination System (NPDES) permits and the pretreatment program, while the U.S. Army Corps of Engineers, Los Angeles District, has authority to administer CWA permits for the discharge of dredge or fill materials in Arizona's waters. EPA Region IX also has authority to require groundwater monitoring and remediation in accordance with CERCLA.

### 7.4.2 Federal Laws Impacting Groundwater Quality

The Safe Drinking Water Act (SDWA) is the primary federal law regulating groundwater quality. In particular, it regulates drinking water which includes groundwater. The CWA, which regulates surface water, also impacts groundwater quality. The CERCLA and the Resource Conservation and Recovery Act (RCRA) impact groundwater management through the regulation of hazardous waste and sites contaminated by hazardous waste. Following is a brief overview of these federal laws and their impacts on the Department's water quality management.

#### 7.4.2.1 Safe Drinking Water Act

The Safe Drinking Water Act was enacted in 1974 to regulate drinking water. ADEQ has been delegated authority by the EPA to implement the SDWA and "to ensure that all potable water distributed or sold to

the public through public and semi-public water systems is free from unwholesome, poisonous, deleterious, or other foreign substances and filth or disease causing substances or organisms." A.R.S. § 49-351(A).

There are two types of standards set by the SDWA: national primary drinking water regulations and national secondary drinking water regulations. National primary drinking water regulations may either be primary Maximum Contaminant Levels (MCLs) or Treatment Techniques (TT) requirements. Primary MCLs are the maximum permissible level of a constituent in a public water system and constitute the enforceable standard for safe drinking water. TT requirements set action levels for constituents such as lead and copper that cannot be directly detected or removed by water systems. National secondary drinking water regulations, referred to as secondary Maximum Contaminant Levels (SMCLs), set non-enforceable numeric standards for the aesthetic quality of the water, such as taste, odor, or color. Waters with contaminants above the SMCLs are not typically expected to cause health problems. ADEQ has adopted the EPA MCLs as state Drinking Water Standards and has the authority to adopt more stringent standards as well.

Although the Department does not directly regulate drinking water quality, the presence of contaminants in groundwater does negatively impact water quality for municipal providers and poses significant water management issues for drinking water systems.

#### 7.4.2.2 Clean Water Act

The CWA, first passed in 1972, is the comprehensive federal statute regulating surface water quality. The CWA contains six major elements: (1) the NPDES permit program which regulates discharges of pollutants by any person to the nations waters and is designed to protect the chemical and biological integrity of the nation's waters, (2) technology-based effluent standards that apply to the quality of a discharge from a facility, (3) state ambient water quality standards, (4) dredge and fill permits designed to protect the physical and biological integrity of the nation's waters, (5) oil and hazardous substance spill liability, and (6) federal grant programs for improvement of municipal water treatment.

Under the NPDES permit program, all point source dischargers of pollutants into "waters of the United States" must obtain a permit. The jurisdictional reach of the CWA extends to "navigable waters" which are defined as "waters of the United States, including the territorial seas." 33 U.S.C. § 1362(7). EPA and the Corps define "waters of the United States" to include interstate waters; waters which are used, were used in the past or may be susceptible to use in interstate or foreign commerce; tributaries to such waters; the territorial sea and wetlands. 40 C.F.R. § 122.2; 33 C.F.R. § 328.3(a). A frequently cited definition of "waters of the United States" is:

> any waterway within the United States also including normally dry arroyos through which water may flow, where such water will ultimately end up in public waters such as a river or stream, tributary to a river or stream, lake, reservoir, bay, gulf, sea or ocean within or adjacent to the United States. *U.S. v. Phelps Dodge Corp.*, 391 F. Supp. 1181 (D. Ariz. 1975).

Based on this "tributary rule," the CWA has potential application to dry land which drains into a water of the U.S. Additionally, EPA interprets waters of the U.S. to include wetlands, areas susceptible to use as habitat by migratory wildfowl, and areas where industries engaged in interstate commerce discharge. 44 Fed. Reg. 32854, 32858 (June 7, 1979); 51 Fed. Reg. 41206, 41217 (Nov. 13, 1986). "Point source" means:

> any discernible, confined and discrete conveyance including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal

feeding operation or vessel or other floating craft, from which pollutants are or may be discharged. 33 U.S.C. § 1362(11).

"Pollutant" includes dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal and agricultural waste discharged into water. 33 U.S.C. § 1362(6). Based on the expansive definitions of "waters of the U.S.," "point source" and "pollutant," the jurisdictional reach of the CWA NPDES program is quite broad. EPA has also implemented an NPDES storm water permit program that regulates municipal and industrial runoff which eventually discharges to waters of the United States.

NPDES permits that allow discharges to canals or river systems as a result of remedial projects or by wastewater treatment facilities are important to the Department's overall water management strategy. As a result, the Department provides input on related reports and draft NPDES permits that may impact the water management activities in the state. Furthermore, non-point source contamination of groundwater by such substances as nitrate, sulfate, and dissolved solids can render large volumes of groundwater unusable for many purposes and pose serious water management problems. Therefore, the Department monitors statutory and programmatic developments as well as permits and reports related to non-point source discharges under the CWA.

The CWA also provides for area-wide, long range planning processes to mitigate water quality control problems in selected areas which result from urban and industrial wastewater. Because such planning processes provide a comprehensive review of wastewater treatment and reuse options, the Department participates in such plans and amendments and provides technical assistance to local councils of government who administer the plans.

#### 7.4.2.3 Comprehensive Environmental Response, Compensation, and Liability Act

CERCLA and the Superfund Amendments and Reauthorization Act, commonly referred to as the federal Superfund program, authorize investigation and remediation of groundwater contaminated by releases of hazardous substances. Groundwater remediation may be required to comply with MCL standards, although less stringent standards may be approved by EPA on a case-by-case basis through a technical waiver process. In Arizona, CERCLA establishes a comprehensive response program which is administered by ADEQ in cooperation with the EPA. The Department also plays an advisory role in this process.

Under Section 105 of CERCLA, the EPA is required to annually update the National Priorities List (NPL) of Superfund sites. The sites are proposed for inclusion on the NPL after being assessed as to the release of hazardous substances that threaten public health and the environment. Two significant components in the Superfund process are site investigation (Remedial Investigation) and evaluation of possible cleanup alternatives (the Feasibility Study). During the Remedial Investigation, information is gathered to determine the general nature, extent, and sources of contamination at a site. Once the final cleanup plan has been selected, EPA formalizes this decision by signing a "Record of Decision" (ROD). The ROD also contains a Responsiveness Summary which is EPA's response to public comments on the Remedial Investigation, Feasibility Study, and Proposed Plan. Design and actual cleanup activities (Remedial Design and Remedial Action) can then proceed.

The Department regularly participates in the CERCLA program activities, primarily for sites located within AMA boundaries. The Department's concern at CERCLA sites is that any groundwater that is withdrawn and remediated be put to reasonable and beneficial use. The Department participates on CERCLA technical committees and serves in an advisory capacity for monitoring and extraction well installation, source control projects, and permitting.

#### 7.4.2.4 Resource Conservation and Recovery Act

RCRA established a national hazardous waste management program in 1976. Under RCRA, hazardous waste permits are issued for the treatment, storage, and disposal (TSD) of hazardous wastes. Individual permits issued to these facilities specify design, performance and operational standards which include groundwater monitoring. Hazardous waste facilities also undergo a closure process once operations are reduced or terminated. Moreover, corrective action may be required at TSD facilities and may include groundwater monitoring.

ADEQ has been delegated authority for the implementation of RCRA requirements in Arizona. The Department's participation at RCRA sites is important for water management activities, particularly in regard to well siting, use permits, and end use issues.

### 7.4.3 ADEQ Programs that Impact Department Groundwater Quality Activities

The EQA established the ADEQ and created a strong and comprehensive water quality management structure. ADEQ's programs that protect groundwater resources include water quality assessments, groundwater monitoring, pollutant discharge, permitting activities, and remediation activities. The following are selected water quality protection programs which fall under the jurisdiction of ADEQ and have a direct impact on Department activities.

#### 7.4.3.1 Aquifer Water Quality Standards

Arizona's Aquifer Water Quality Standards (AWQSs) are the cornerstone of the state's groundwater protection program. Arizona has adopted the federal primary MCLs, established under SDWA, as numeric AWQSs. A.A.C. R18-11-406. These standards apply to aquifers classified and protected for drinking water use. Because all aquifers in Arizona are classified and protected for drinking water use, Arizona's AWQSs are enforceable standards for water quality in all of Arizona's aquifers. A.R.S. § 49-224(B).

ADEQ may reclassify an aquifer within an AMA, upon consultation with the appropriate Groundwater Users Advisory Council and upon conducting a public hearing, for a projected use other than drinking water if the identified aquifer is hydrologically isolated from the other aquifers or other portions of the same aquifer, water from the identified aquifer is not being used as drinking water, and the benefits to the public of the resulting water quality degradation outweigh the costs. A.R.S. § 49-224(c).

Arizona has also adopted narrative AWQSs to regulate pollutant discharges for which no numeric standards have been developed. Arizona's narrative AWQSs include the following: (1) a discharge shall not cause a pollutant to be present in an aquifer classified for a drinking water protected use in a concentration which endangers human health, (2) a discharge shall not cause or contribute to a violation of a surface water quality standard established for a navigable water of the state, and (3) a discharge shall not cause a pollutant to be present in an aquifer which impairs existing or reasonably foreseeable uses of water in an aquifer. A.A.C. R18-11-405.

#### 7.4.3.2 Aquifer Protection Program

The most comprehensive ADEQ groundwater protection program is the APP system, established by the EQA in 1986 and implemented by rule in 1989. An individual or general permit is required for any person who discharges or who owns or operates a facility that discharges a pollutant from a facility either directly into an aquifer or to the land surface or the vadose zone in such a manner that there is a reasonable probability that the pollutant will reach an aquifer. A.R.S. §§ 49-201(11), 49-241. Discharging facilities that require either an individual or general permit to operate include surface impoundments, solid waste disposal facilities, injection wells, land treatment facilities, facilities which add a pollutant to an assortment

of salt formations, dry well or underground cave or mine, mine tailings piles and ponds, mine leaching operations, large septic tank systems, effluent recharge projects, point source discharges to waters of the U.S. and sewage or sludge ponds and waste water treatment facilities. A.R.S. § 49-241(B). Classes or categories of facilities which are exempted from APP requirements are identified in A.R.S. § 49-250. General permits are issued by rule and individual permits must be applied for.

APPs require a demonstration that AWQSs are maintained and the Best Available Demonstrated Control Technology (BADCT) is applied. For individual APPs, compliance with AWQSs is measured at a designated point of compliance. BADCT requirements ensure that the greatest degree of discharge reduction is achieved through an evaluation of site-specific engineering, environmental, and economic criteria.

APPs may require compliance with best management practices (BMPs). BMPs are often site design techniques for the purpose of water quality protection. BMPs may be adopted for on-site facilities for urban runoff, storm sewers, silvicultural activities, and septic tank systems. Agricultural general permits require compliance with BMPs for nitrogen fertilizer application and concentrated animal feeding operations. ADEQ is required to monitor compliance with the established BMPs and to measure BMPs effectiveness.

Department staff receives and reviews all APPs for any impacts on Departmental programs and water management. In particular, the Department coordinates with ADEQ to review APP applications for potential harmful water quality impacts on groundwater conditions. Pursuant to A.A.C. R18-9-109, ADEQ advises the Department of each APP application received for a facility that is a recharge project or an underground storage and recovery project. One of the conditions for the issuance of an underground storage facility permit is that ADEQ must determine that the facility is not in a location which will result in pollutants being leached to the groundwater table so as to cause unreasonable harm. A.R.S. § 45-811.01(C). Facilities exempt from APP provisions may instead be required by the Department in consultation with ADEQ to meet other requirements to mitigate harmful water quality impacts to the aquifer.

#### 7.4.3.3 Wellhead Protection Program

An important addition to Arizona's groundwater protection program has been the development of the Wellhead Protection Program which fulfills federal requirements of section 1428 of the SDWA by designating Wellhead Protection Areas around public drinking water systems. The Wellhead Protection Program is a voluntary program which encourages the protection of all wells, not just public drinking water system wells. Local entities that have the authority to control land use and exercise other management options can implement wellhead protection, therefore encouraging the creation of local programs.

#### 7.4.3.4 Reuse Permits

Reuse permits are issued to facilities which provide wastewater for reuse. A reuse permit specifies the amount of effluent to be reused and its chemical quality. ADEQ wastewater reuse rules (A.A.C. R18-9-701, *et seq.*) set the criteria for the use of treated effluent, or reclaimed water, for purposes such as agricultural irrigation, turf irrigation, and recharge. The current reuse rules prescribe numeric reclaimed water quality criteria and monitoring requirements for specific reuse applications. In general, these rules prescribe allowable limits for pH, total fecal coliform, turbidity, enteric viruses, and certain parasites. Reuse may be limited depending on the quality of source water and the intended use.

Wastewater reuse rules undergo periodic updating through the ADEQ's rule making process. The Department reviews any proposed changes to the wastewater reuse rules to ensure the protection of public health and groundwater supplies while maximizing the use of a significant renewable water supply. The

Department evaluates effluent reuse permits issued by the ADEQ and encourages the use of treated effluent where appropriate.

### 7.4.3.5 Underground Storage Tanks

ADEQ's Underground Storage Tank (UST) program was developed to ensure the proper operation of underground storage tanks and to prevent and remediate releases. Under state regulation and RCRA amendments, the UST program consists of notification requirements, technical standards for new and existing USTs, leak detection and closure criteria, corrective actions for remediation, and financial responsibility demonstrations. Leaking USTs in a concentrated area can present detrimental impacts on groundwater quality and supplies.

The Department has the authority to issue poor quality groundwater withdrawal permits for water contaminated by USTs. The Department can provide guidance for UST site remediation projects to ensure the beneficial use of remediated water.

### 7.4.3.6 Water Quality Assurance Revolving Fund

The WQARF Program, sometimes referred to as the state Superfund program, was created as part of the EQA. WQARF monies are used to protect the waters of our state against hazardous substances, and may be used in conjunction with federal funds. Funds can be used for statewide water quality monitoring, health and risk assessment studies, and remediating hazardous substances which threaten the waters of the state. Mitigation of non-hazardous substances is also allowed under specified conditions. A.R.S. § 49-286. Each year, ADEQ develops a list of environmentally threatened sites which qualify for WQARF monies. Funds are used at those sites to mitigate existing contamination or to prevent further spread of pollutants which may threaten our water supplies. A priority list is developed by ADEQ based on such things as the degree of risk to the environment and other available funding sources.

Some of the key legislative changes made in the 1997 WQARF reform package include: establishment of a proportional share liability for cost allocation to responsible parties; creation of the neutral party arbitration process, with incentives to encourage early settlements, and disincentives to responsible parties which do not enroll in the neutral party arbitration process; new ADEQ funding mechanisms designed to protect existing wells against migrating contamination from WQARF sites; the creation of a comprehensive WQARF site registry, which consolidates a number of separate lists which were previously used; the inclusion of petroleum releases in the WQARF Program under some circumstances; and increased flexibility in the selection of groundwater remedies.

ADEQ follows a process for management and cleanup of WQARF sites that consists of site identification and characterization, site prioritization, remedy selection, identification of end uses, implementation and monitoring, and closure. The criteria to be used in evaluation of response actions include practicability, risk, cost, and benefit. This process also includes a comparison of alternatives based on established statutory criteria, developing a Remedial Action Plan, providing public comment, and issuing a Record of Decision. The Department of Water Resources will actively coordinate with ADEQ in the planning and implementation of groundwater cleanup actions under WQARF.

### 7.4.3.7 Water Infrastructure Finance Authority

In 1989, the Arizona Legislature created the Wastewater Management Authority to administer funds granted to the state pursuant to the federal SDWA. These funds, which required a 20 percent state match, were loaned to wastewater treatment systems in the state for assistance in meeting requirements of the SDWA. The ADEQ made loans for this purpose from monies in the ADEQ wastewater treatment revolving fund.

In 1997, this administrative body was amended by the Legislature and renamed the Water Infrastructure Finance Authority (WIFA). The authority for WIFA was expanded to make loans available to drinking water systems in addition to wastewater treatment systems for assistance in meeting requirements of the SDWA. The state funding source was also changed so that monies made available to these systems are now derived from the drinking water revolving fund. The Department participates on the advisory board which oversees the WIFA and has an interest in viability of water systems and SDWA compliance.

### 7.4.4 Department of Water Resources Programs Related to Groundwater Quality

The Department protects groundwater quality by considering groundwater quality issues in its permitting process and water quantity management programs. As a result of WQARF reform legislation of 1997, the Department has increased its responsibility in the program to coordinate and provide assistance to WQARF activities. Among other things, the bill provides for:

- annual funding for Department WQARF activities,
- database development and coordination with ADEQ,
- groundwater withdrawn pursuant to certain cleanups to be accounted for in the same manner as surface water for the purpose of determining compliance with conservation requirements,
- amendment of the Assured Water Supply Rules,
- active involvement by the Department in all phases of site assessment, remediation, management, operation, and planning strategies,
- a WQARF Advisory Board on which the Department has a seat, and
- a well inspection program through which wells that are contributing to vertical cross-contamination may be identified and modified.

The Department's existing permits and programs which involve groundwater quality issues as well as its new programs for groundwater quality protection based on the WQARF legislation are discussed in the following section.

#### 7.4.4.1 Poor Quality Groundwater Withdrawal Permits

Appropriate use of poor quality groundwater conserves the existing supply of potable groundwater. The Department issues poor quality groundwater withdrawal permits to allow the withdrawal of groundwater which, because of its quality, has no other beneficial use at the present time. A.R.S. § 45-516. Withdrawal permits are issued by the Department, and the withdrawal must be consistent with the AMA management plan. Permits are usually issued in conjunction with CERCLA, WQARF, or leaking UST sites for pump and treat operations. To increase the appropriate uses of poor quality groundwater during the third management period, the Department continues to encourage matching poor quality groundwater with beneficial uses within the AMA.

#### 7.4.4.2 Assured Water Supply

The Assured Water Supply Program (AWS Program) is a consumer protection program that ensures that new subdivisions have a secure supply of water with adequate quality for at least 100 years. Pursuant to A.R.S. § 45-576, before land may be subdivided, the developer of the property must either obtain a Certificate of Assured Water Supply for the subdivision from the Department or must establish the development as a customer of a municipal water provider that the Department has designated as having an assured water supply.

Pursuant to rules governing the AWS Program set forth at A.A.C. R12-15-701, *et seq.*, in order to establish an assured water supply, the applicant must prove that a supply of water is physically, legally, and continuously available for the 100-year period to meet the demands of the development that will be the

subject of the certificate, or in the case of a designation, to meet current and committed demands of the water provider for the 100-year period. The applicant must also establish that projected water use will be consistent with achievement of the management goal for the active management area and that the applicant has the financial capability to construct the physical facilities necessary to serve the development. In addition, the applicant must establish that the water supply pledged for assured water supply purposes is of adequate quality.

In assessing the quality of a groundwater supply pledged for assured water supply purposes, the Department works closely with ADEQ to determine whether the groundwater supply meets ADEQ standards for the purposes for which the water is pledged. If the groundwater is not of adequate quality, the applicant may need to find alternative water sources or to expend additional resources treating the groundwater to meet the ADEQ standards.

#### 7.4.4.3 Underground Water Storage and Recovery

Underground water storage, also known as recharge, will play an important role in achieving the Phoenix AMA's goal of safe-yield. Recharge projects will store CAP water that is currently not used directly. Credits for recharged CAP water will then be available to water providers and developers to establish an assured water supply. Other stored CAP water, particularly that stored underground by the Arizona Water Banking Authority, will be available to protect municipal and industrial CAP users from future shortages or outages on the CAP system. In addition, recharge of effluent can be used as a tool to allow more complete use of that resource.

The underground water storage program is administered by the Department. Permits must be obtained from the Department prior to undertaking recharge activities. The Department coordinates closely with ADEQ to ensure that underground water storage does not adversely impact existing aquifer water quality and does not cause movement of existing groundwater contamination. If effluent is stored underground, the applicant must obtain an APP from ADEQ, in addition to the underground storage permits required from the Department.

#### 7.4.4.4 Well Spacing/Impact Analysis

A.R.S. § 45-598 and the Department's temporary Well Spacing and Well Impact Rules are in place to prevent unreasonable damage to surrounding wells as well as land and water users due to new wells and new withdrawals of groundwater in an AMA. Specifically, these laws require well impact studies to evaluate the potential for new non-exempt wells and new withdrawals to damage land and other water users, particularly existing wells. The Department conducts the impact studies for wells with a maximum discharge of 500 gallons per minute (gpm) or less. For wells with a maximum discharge rate exceeding 500 gpm, the permit applicant must submit a hydrological study of projected water level declines due to the operation of the proposed well. The study must also assess adverse impacts from the migration of poor quality groundwater. The well permit application may be denied if the Department determines that the proposed well would cause an unreasonable and adverse impact on surrounding wells, additional regional land subsidence, or migration of poor quality groundwater.

#### 7.4.4.5 Well Construction and Abandonment Requirements and Licensing of Well Drillers

If wells are not constructed, sealed, or abandoned properly they can act as conduits for contaminant flow from the surface to groundwater or between aquifers. Improperly constructed wells can contribute to groundwater contamination. The Department's rules governing well construction, abandonment, and driller licensing, set forth at A.A.C. R12-15-801, *et. seq.,* are summarized below.

- Minimum well construction and abandonment requirements prevent entry of fluids at and near the surface and minimize the possibilities of migration and inadvertent withdrawal of poor quality groundwater. These requirements also prohibit the use of hazardous materials in the construction of wells.

- Installation, modification, abandonment, or repair of all wells in Arizona must be performed by a driller licensed by the Department. The licensing procedure includes the administration of written examinations to test the applicant's knowledge of state regulations, hydrologic concepts, and well construction principles and practices.

- Disposal site restriction prevents the use of wells as disposal facilities for any material that may pollute groundwater.

- Special standards may be required by the Department if the minimum well construction requirements do not adequately protect the aquifer or other water users.

- Open wells must be capped with a watertight steel plate.

- Except for monitor and piezometer wells, no well shall be drilled within 100 feet of any septic tank system, sewage disposal area, landfill, hazardous waste facility or storage area, or petroleum storage areas and tanks, unless authorized by the Director.

Wells drilled prior to the enactment of the well construction rules (effective March 5, 1984) were not required to be constructed in accordance with minimum well construction standards. If a pre-rule well is replaced or modified, however, the new or modified well must meet the current well construction standards. See A.R.S. §45-594.

### 7.4.4.6 The Department's Role in the WQARF Program

The Department's involvement in groundwater remediation has been redefined as a result of the Groundwater Task Force, which conducted an extensive series of stakeholder negotiations designed to promote groundwater cleanup and groundwater quality management activities of remedial sites. Involvement in this development process was widespread and representative of a varied group of private and public interests.

#### 7.4.4.6.1 Department Activities in the WQARF Site Cleanup and Management Process

ADEQ's WQARF site cleanup and management process and the Department's role in that process are described in the following discussion.

Site Identification and Characterization

Existing WQARF sites have been identified and are being managed by ADEQ. Additional sites may be identified in the future based on a preliminary investigation by ADEQ to determine the potential risk to public health, welfare, or the environment. The Department will further assist ADEQ in this process by providing resource data which includes well location and pumpage records, water rights information, and any other appropriate data recorded by the Department.

Characterization of sites is important because the nature and extent of contamination must be understood before remedies can be selected and implemented. An important part of site characterization is an evaluation of how contamination impacts current and future groundwater uses. The Department's role may include such activities as site inspections and evaluations, review of investigations, field work such as

well inspection and water quality sampling, identification of potential water management issues, and any other characterization as appropriate. Department computer models may be useful in characterizing groundwater flow patterns.

Site Prioritization

The results of the preliminary investigation will be used by ADEQ for site scoring using a method to be established in rules adopted by the director of environmental quality. The completed preliminary investigation will be used by ADEQ to either make a determination of no further action on a site, or to prepare the site for inclusion on the Site Registry. In this latter case, a Site Registry report is prepared containing a description of the site, with its geographical boundaries indicated, and a score in accordance with the site scoring method to be established in rules and adopted by the ADEQ. The Department will assist ADEQ by sharing pertinent water resource information as described in the previous subsection.

Remedy Selection

ADEQ has established a list of response actions to be considered when managing a site. Based on the potential impact on current and future water uses, a potential remedy must be evaluated and designed. Each remedy is site-specific. The Department will assist in defining potential remedies to ensure that the remedy is consistent with Department management plans and sound groundwater management practices that are publicly acceptable. Ultimately, the Department's level of assistance will vary based on the remedy selected. Possible remedies are discussed below.

- Plume Remediation

Plume remediation, or aquifer restoration, means achieving appropriate water quality standards for groundwater throughout the affected area. Source control and monitoring will likely be essential elements of this strategy. This remedy may be more effective for smaller plumes which can be remedied within reasonable time frames.

- Physical Containment

Physical containment refers to an approach that contains contaminants within defined boundaries. This strategy could consist of plume control and coordination of groundwater pumpage and recharge to ensure that contamination is confined within a defined area. Source control and monitoring are also likely elements of this strategy. Physical containment may be appropriate where potable water supplies are threatened by contaminant migration and where containment is technically feasible, but it may require extensive groundwater management to implement.

- Controlled Migration

This strategy aims to control but not necessarily contain migration of contaminants. Source control and monitoring are likely elements of this strategy. Control of contaminants can include control and/or coordination of pumpage that affects contaminant migration and any other measures taken to control contaminant migration. Controlled migration may be appropriate for larger plumes which cannot be practically remedied or contained.

- Source Control

Source control is reduction of continuing contaminant sources such as soil contamination or areas of high concentrations of volatile organic compounds (VOCs) or other contaminants. Dense non-aqueous phase liquids (DNAPLs), which are contaminants (such as VOCs) of such high concentrations that they are not

dissolved in groundwater but exist as free phase liquids, are an example of contaminant sources. Source control is a remedial action that often results in the highest volume of contaminants removed per unit cost.

This strategy employs controlling the pollutant at the source to ensure that aquifer contamination does not continue on due to uncontrolled contaminant releases. Monitoring is a likely component of this strategy. Source control can include, but is not limited to, the mitigation of sorbed or free phase contaminants, pumpage of groundwater to contain or control significant sources of contaminants, and the removal of contributing contaminant sources.

- Monitoring

The monitoring remedy involves monitoring instead of other remedy options. Monitoring sites for water quality and groundwater levels is important to determine the extent of contamination and the effectiveness of remedial activities. The incorporation of computer groundwater models may be used to predict contaminant movement, to monitor well locations, and to develop contingency plans for more aggressive remedies, if necessary.

- No Action

This alternative consists of taking no action at a site. This strategy is normally included as a baseline condition for comparison purposes, but may be a viable alternative in limited cases. Generally, this alternative would only be chosen for sites that are geographically isolated from populated areas, do not pose a significant threat to water supplies, or would be used for comparative purposes to other sites.

Identification of End Uses

The Department is committed to the beneficial use of groundwater withdrawn and treated at WQARF sites, along with other areas that have degraded groundwater quality, and will assist ADEQ with the identification and facilitation of designated end uses for remedial projects. These end uses should be consistent with those determined for existing sites as well as the development of new end uses to match the intended use.

Implementation and Monitoring

The implementation and monitoring phase of a site activity includes construction, startup, monitoring, operation and maintenance, and any other appropriate activities. The Department will assist ADEQ in this phase through the following activities where appropriate: field work, review of groundwater analyses, appropriate groundwater and assured water supply accounting, and any other appropriate activities.

Site Closure

ADEQ must certify that site goals have been attained in order to discontinue cleanup activities. Department staff assist in evaluation of sites and certification of site closure. The Department assists and may need to identify alternative water sources to replace remediated water when sites are closed.

#### 7.4.4.6.2 Department Policies for WQARF Site Cleanup and Management

In general, site plans should be consistent with the management goal of the AMA in which the site is located. A.R.S. §§ 49-282.06(F); 45-105(B)(4)(c). Therefore, the Department will implement policies during the third management period for the management and cleanup of remedial sites in cooperation with the ADEQ. These policies will ensure that AMA goals are addressed when remedial actions are planned. The Department supports proposed remedial projects when they are appropriate, but believes that remedies

must make sense from a groundwater management perspective. The principles which will be used to formulate these policies are described below.

Water should be used consistent with water allocation concepts in Title 45

This policy requires that entities using water withdrawn pursuant to cleanups, whether under CERCLA, WQARF, RCRA, voluntary, or other sites, possess appropriate authorities for the use of groundwater (such as permits or water rights).

The Department supports source control cleanups to protect water sources

Source control, which controls pollution at its source, can be the most cost effective and practicable approach to cleanups. Many wells have been rendered unsuitable for potable use due to migrating contamination. Source control projects to protect wells that are threatened by contaminant migration are generally supported by the Department. Pollution prevention is also a significant component of mitigating contaminant migration.

Any groundwater withdrawn must be put to reasonable and beneficial use

Reasonable and beneficial use of groundwater withdrawn is a policy that applies to all cleanups. Any withdrawals of 100 acre-feet or less annually may qualify for de minimis status and be exempted from beneficial use requirements, but the Department will evaluate de minimis exemptions from this policy on a case-by-case basis. In the case of leaking UST sites, the Department generally exempts sites that annually pump less than 10 or 15 acre-feet.

Contaminated groundwater represents a resource that will be important

Even if groundwater is contaminated, it represents a resource that can be used for both potable and non-potable uses. Potable uses must meet the state AWQSs and federal Drinking Water Standards which govern public consumption of potable water. ADEQ and the Arizona Department of Health Services intend to develop end use standards for non-potable uses that, if implemented, will make large volumes of groundwater usable again. The Department will cooperate in the development of non-potable end use standards and will develop policies for appropriate end uses based on the new standards.

Containment remedies that involve massive groundwater withdrawals to achieve regional groundwater flow control are generally inappropriate and will not be supported by the Department

In some cases, massive groundwater withdrawals of uncontaminated or only slightly contaminated water may be considered to control migration of contaminant plumes or for other purposes. In general, the Department considers these kinds of proposed remedies to be wasteful of groundwater and not very cost-effective.

#### 7.4.4.6.3 Statutory Mandates for the Department's Involvement in the WQARF Program

The 1997 WQARF reform legislation mandates that the Department implement certain water quality programs and provides for expanded Department involvement in water quality management. New Department programs and responsibilities based on the 1997 WQARF reform legislation include the following:

Remediated Groundwater Incentives

The WQARF reform legislation of 1997 directs the Department to include in the management plans developed pursuant to A.R.S. § 45-566 (the Third Management Plans) provisions to encourage the beneficial use of groundwater that is withdrawn pursuant to approved remedial action projects under CERCLA or Title 49, Arizona Revised Statutes. Laws 1997, Ch. 287, § 51(A).

- Remediated Groundwater Incentive for Conservation Requirement Accounting

In order to encourage the beneficial use of remediated groundwater, the Legislature specifically mandated:

> In determining compliance with applicable conservation requirements adopted pursuant to sections 45-566, 45-567 and 45-568, Arizona Revised Statutes, the department of water resources shall account for groundwater withdrawn pursuant to approved remedial action projects under CERCLA or title 49, Arizona Revised Statutes, consistent with the accounting for surface water.

Laws 1997, Ch. 287, § 51(B).

- Remediated Groundwater Incentive for Assured Water Supply Accounting

In addition, the WQARF reform legislation of 1997 directs the Department to consider specified amounts of groundwater withdrawn pursuant to approved remedial action projects as consistent with the management goal of the active management area from which it is withdrawn for purposes of the Department's AWS Program. Laws 1997, Ch. 287, § 52. The Legislature mandated that:

> For each calendar year until 2025, the use of up to an aggregate of sixty-five thousand acre-feet of groundwater withdrawn within all active management areas pursuant to approved remedial action projects under CERCLA or title 49, Arizona Revised Statutes, shall be considered consistent with the management goal of the active management area.

Laws 1997, Ch. 287, § 52(A).

Once the aggregate volume of 65,000 acre-feet of remediated groundwater use by all users in all active management areas is reached in a year, the use of an additional amount of remediated groundwater is consistent with the management goal of the active management area based on a sliding scale. In the third management period, fifty percent of the total volume withdrawn in excess of the 65,000 acre-feet will be consistent with the management goal. Laws 1997, Ch. 287, § 52(B). By the year 2025, the remediated groundwater incentive for assured water supply accounting decreases to zero.

A municipal provider must apply for a remediated groundwater accounting for an assured water supply determination prior to January 1, 2010. The amount of groundwater determined to be consistent with the management goal cannot exceed the amount that the municipal provider is legally obligated to withdraw or use and does not extend beyond 2025. Laws 1997, Ch. 287, § 52(C).

Annual groundwater withdrawals of 250 acre-feet or less that are withdrawn pursuant to an approved remedial action project shall not be debited against the water provider's assured water supply mined groundwater account and shall not be subject to a replenishment obligation. The water provider must notify the Department of its compliance with the exemption. Annual withdrawals of 250 acre-feet or less of remediated groundwater will not count against the 65,000 acre-feet per year total volume. Laws 1997, Ch. 287, § 52(E).

- Coordination with ADEQ in Evaluating Proposed Remedial Actions

Pursuant to A.R.S. § 45-105(B)(4)(c), the Department is required to actively coordinate and confer with ADEQ in evaluating proposed remedial actions to provide ADEQ with information regarding water resource considerations. The Department will coordinate and confer with ADEQ prior to ADEQ's approval or denial of a proposed remedial action project. Once a remedial action project is approved by ADEQ or the EPA pursuant to CERCLA or Title 49, A.R.S., the Department will account for remediated groundwater in accordance with Laws 1997, Ch. 287, §§ 51 and 52. Among other things, the Department will consider the following factors relating to proposed remedial actions in its recommendations to ADEQ:

- Volume of remediated groundwater to be withdrawn

The Department will encourage remedial actions that use the least amount of groundwater necessary to facilitate a project's remedial goal and will discourage remedial actions that are not prudent and efficient from a groundwater management perspective.

- End uses to which remediated groundwater will be put

The Department will encourage end uses that minimize groundwater withdrawals and that are consistent with the safe-yield goal because they will result in no change in groundwater storage. Where remediated groundwater cannot be practicably or cost-effectively re-injected or recharged, the Department will encourage replacing existing groundwater uses with remediated groundwater and preventing new permanent uses which would not have occurred without the incentive to use remediated groundwater and which would continue to rely on groundwater after the remediated groundwater is no longer available.

While individualized circumstances will be evaluated on a case-by-case basis, generally, the Department's beneficial end use preferences are the following, listed in order from most to least preferred based on the impact on the active management area's management goal and the amount of groundwater in storage:

Neutral to local aquifer

a. Re-inject or recharge in the same local area.
b. Replace existing groundwater uses in the same local area.

Neutral to groundwater basin

c. Re-inject or recharge in the same active management area.
d. Replace existing groundwater uses in the same active management area.

Reduce groundwater in storage

e. Replace existing non-groundwater use in the same active management area.
f. Beneficial uses of water for new purposes.
g. Artificial wetlands or artificial lakes.
h. Dispose to the sewer (unless the resulting effluent is re-injected, recharged or replaces an existing groundwater use).

- Achievement of maximum beneficial use of waters and viability of proposed remedial action

Remedial actions must assure the protection of public health and welfare and the environment; to the extent practicable, provide for the control, management or cleanup of hazardous substances so as to allow the maximum beneficial use of the waters of the state; and be reasonable, necessary, cost-effective and technically feasible. A.R.S. § 49-282.06(A).

- Consistency with Title 45

Groundwater withdrawn pursuant to an approved remedial action must be withdrawn and used consistent with Title 45, Arizona Revised Statutes.

Well Inspection, Modification or Replacement

The Department is required by the 1997 WQARF legislation to develop rules for well inspections. An evaluation of the extent of the cross-contamination problem will be performed by the Department in cooperation with ADEQ and other stakeholders.

Construction of New Wells In and Near WQARF Sites

The 1997 WQARF legislation mandates that the Department ensure that new or replacement wells in areas of known groundwater contamination are constructed in such a manner that cross-contamination does not occur. Department staff will screen Notices of Intent to Drill that are submitted to ensure that wells are properly constructed. The Department will establish policies and procedures to implement this directive, including procedures to effectively communicate with well owners and drillers.

Abandonment of Wells in and Near WQARF Sites

Department staff will review and evaluate Notices of Intent to Abandon to ensure that abandonment of wells is done in accordance with Department rules and that potential for cross-contamination is minimized.

## 7.5 WATER QUALITY ASSESSMENT

A water quality assessment must be included in management plans pursuant to the Code. The assessment provides an overview of water quality concerns in the Phoenix AMA. The following section discusses goals and objectives of the assessment, water quality of renewable and groundwater supplies, the constituents of concern in the Phoenix AMA and their impact on water management, and specific contamination areas in the Phoenix AMA.

### 7.5.1 Assessment Goals and Objectives

The primary goal of the Water Quality Assessment is to provide a general evaluation of groundwater and surface water quality conditions in the Phoenix AMA and to identify the interface of water quality concerns with the regional water supply. The impact of water quality on water resource management has become more important in recent years due to such factors as stringent water quality standards, conjunctive use of water supplies, groundwater management at remediation sites, and increasing levels of public concern.

The municipal, agricultural, and industrial sectors have distinctive demand patterns and requirements for water quality. For example, state law prohibits direct use of treated effluent for potable use, but treated effluent is used for turf irrigation, agricultural irrigation, cooling towers, and groundwater recharge. Water that is high in total dissolved solids may be inappropriate for agricultural irrigation but may be usable for some industrial applications. Conversely, water that is high in nitrate could provide a good end use for agriculture, but does not meet potable standards. During the third management period, the Department will evaluate the matching of water quality characteristics with appropriate end uses while ensuring compliance with applicable laws and rules for each end use.

### 7.5.2 Renewable Water Supplies

Renewable water supplies include CAP water, non-CAP surface water, and effluent. The quality of these waters is discussed in this section.

#### 7.5.2.1 Surface Water Other Than Central Arizona Project Water

Surface water quality in the Phoenix AMA is generally good. Most surface water that is not supplied by the CAP is supplied by the Salt River Project (SRP) which comes from the Salt and Verde Rivers. SRP surface water typically contains total dissolved solids (TDS) levels below 500 mg/l (milligrams per liter). TDS concentrations are generally a good indicator of overall water quality. Other constituent parameters of SRP surface water generally meet applicable water quality standards with appropriate treatment.

#### 7.5.2.2 Central Arizona Project Water

Another surface water supply that augments the water supply of the Phoenix AMA is CAP water which is diverted from the Colorado River in an open canal. With appropriate treatment, the quality of CAP water is acceptable for most uses.

Total dissolved solids concentrations in CAP water vary depending on the location within the CAP canal system. Seasonal data for TDS levels at various mileposts along the CAP aqueduct from 1991 through 1994 were obtained from the CAP. The seasonal data for this period ranged from approximately 450 mg/l (milligrams per liter) to 720 mg/l for the Phoenix milepost. At the Coolidge milepost, TDS concentrations ranged from about 480 mg/l to 700 mg/l. More information about levels of TDS is contained in section 7.5.4.3 of this chapter.

#### 7.5.2.3 Effluent

Effluent is defined by A.R.S. § 45-101(4) as "water that has been collected in a sanitary sewer for subsequent treatment in a facility that is regulated pursuant to A.R.S. §§ 49-361 and 49-362. Such water remains effluent until it acquires the characteristics of groundwater or surface water." Sanitary sewers are comprised of any pipe or other enclosed conduit that carries any waterborne human wastes from residential, commercial, and industrial facilities. A.R.S. § 45-101(8).

Effluent treated at municipal wastewater treatment plants is a significant source of renewable water supply in the Phoenix AMA. Although not suitable for human consumption without advanced treatment, effluent is suitable for turf irrigation, agricultural irrigation, sand and gravel washing, and several other industrial applications. Effluent from the 91st Avenue wastewater treatment facility is used for industrial purposes at the Palo Verde Nuclear Power Generating Station. Wastewater reuse rules are developed by ADEQ that establish parameters for wastewater reuse options.

Wastewater treatment facilities currently discharge effluent into stream channels. The two largest facilities in the Phoenix AMA are the 23rd Avenue and 91st Avenue wastewater treatment facilities. The 23rd Avenue facility discharges effluent into the Roosevelt Irrigation District canal system, while the 91st Avenue facility discharges into the Gila River downstream from its confluence with the Salt River. Segments of the Gila River downstream from wastewater discharges have perennial flows. Wastewater discharges require an NPDES permit to ensure that water quality parameters are being met.

Constructed wetlands may be developed to further enhance the treatment of effluent and pre-treat water prior to recharge or reuse. Vegetation and microbial activity in wetlands as well as filtration of effluent through the vadose zone (soil aquifer treatment) improve the quality of water containing high concentrations of nitrate and organic carbon. Constructed wetlands are occasionally used as a treatment for

lower quality surface waters and agricultural return flows. Wetland projects are also being evaluated as enhanced treatment for effluent discharges to meet potentially more stringent NPDES permit requirements. Wetlands also enhance wildlife habitat and serve as an educational and recreational resource for the community.

### 7.5.3 Groundwater Supplies

Groundwater is one of the most important sources of water in Arizona. Most of the groundwater in the Phoenix AMA is of acceptable quality for most uses. However, some aquifers have been degraded as a result of contamination.

The introduction of contaminants into aquifer systems degrades groundwater quality and threatens public health and the environment. Contaminants can migrate into areas of potable groundwater due to groundwater pumping or regional groundwater flow patterns. Many areas of the Phoenix AMA are projected to remain dependent on groundwater pumping, thereby potentially causing migration of contaminants. The Department's role in managing potential contaminant migration is through involvement in site-specific and non-site-specific water quality management.

Groundwater that has been degraded has limited beneficial uses due to chemical, biological, or radiological contamination and may have high treatment and delivery costs associated with its use. Despite these limitations, the Department considers poor quality groundwater to be a valuable resource for future water management and encourages appropriate uses of this water supply. Matching the highest beneficial use with poor quality groundwater is an important aspect of water management.

The Central Arizona Groundwater Replenishment District, the Arizona Water Banking Authority, and other entities are actively pursuing recharge of excess CAP water within the Phoenix, Pinal, and Tucson AMAs. The impacts of CAP water recharge on existing groundwater quality are not fully understood at this time. Recognizing that there may be groundwater quality impacts resulting from surface water recharge, the EPA requires states to develop a rule for groundwater under the influence of surface water. ADEQ has proposed a rule (A.A.C. R18-11-405), currently under public review, which would require that groundwater under the direct influence of surface water withdrawn from recharge facilities undergo more extensive treatment than groundwater.

### 7.5.4 Groundwater Constituents and Their Impacts on Water Quality Management

The management of water resources requires an understanding of how water quality impacts aquifer conditions and potential uses. Drinking water quality regulations are developed to ensure that the intended use will not have harmful impacts on human health. The Department and ADEQ evaluate water quality based on ADEQ's numeric and narrative AWQSs as well as EPA's MCLs and SMCLs, commonly expressed as mg/l or micrograms per liter (µg/l). Appendices 7A and 7B provide a more detailed listing of primary and secondary MCLs for selected volatile organic compounds, pesticides, inorganic metals, radiochemicals, and other selected contaminants.

The following sections briefly overview the impact of selected constituents on groundwater management and public health. ADEQ's Arizona Water Quality Assessment was used as a reference to describe the limitations on uses, present and planned remedial activities, and potential uses for poor quality groundwater for each constituent. The Salt River Project water quality report and information from the Department's own databases were used to describe water quality in the Phoenix AMA.

For each constituent, a corresponding map is provided which displays available water quality data for well locations sampled in the Phoenix AMA since 1990. Well sites that produced test results within acceptable water quality standards are displayed in addition to those well locations which exceeded standards. The

groundwater quality maps developed for the constituents depicted on these maps were the result of an interagency effort between the Department and the ADEQ. An interagency team retrieved and analyzed data from a variety of sources including the Department's Registry of Groundwater Rights and Groundwater Site Inventory databases, the ADEQ Groundwater Quality database, and a number of WQARF site project reports.

Other ADEQ databases, such as the UST and Drinking Water Quality databases, were not used because they either did not have compatible well registration identification numbers from which to compare each agency's well information, or they contained non-point source information which cannot be assigned to a specific location such as a well. Consequently, the groundwater quality maps depicted in this section are a product of the practical information available that is compatible with the Department's well identification system and from which both agencies had a high level of confidence in the data presented. The groundwater quality maps provide a general overview of water quality conditions within the AMA. Other reports which are published by the ADEQ may contain additional data which are not reflected on these maps.

#### 7.5.4.1 Nitrate

Nitrates are salts formed from nitrogen compounds and are one of the most common groundwater contaminants detected in Arizona. Low nitrate concentrations in groundwater may originate from natural sources such as organic acids. Elevated nitrate levels are generally attributed to industrial sources, wastewater treatment plants, septic tanks and leach fields, or agricultural fertilizers.

Water containing high levels of nitrate-nitrogen cannot be delivered as a drinking water supply unless it is equal to or reduced below the MCL of 10 mg/l. Adults can tolerate high levels of nitrate-nitrogen, although water containing more than several hundred mg/l can cause gastrointestinal irritation. Water that contains nitrate in concentrations in excess of the MCL can be harmful to infants. Nitrate may also be harmful to livestock at levels exceeding several thousand mg/l.

Nitrate stimulates plant growth and is typically regarded as a desirable constituent under most agricultural and turf irrigated conditions. For this reason, effluent is often sought as a source of irrigation water. Nitrogen fertilizer application rates may be reduced or eliminated if irrigation water contains elevated nitrate levels.

Figure 7-1 displays nitrate well testing data for locations within the Phoenix AMA. Groundwater with nitrate concentrations in excess of the MCL of 10 mg/l is found throughout the Phoenix metropolitan area. Major nitrate concentrations above the MCL are located in West Phoenix, Buckeye, and near Chandler.

#### 7.5.4.2 Sulfate

Sulfate can occur as a natural inorganic constituent of groundwater which originates from the natural dissolution of minerals in aquifers. Elevated concentrations can result from the leaching of industrial wastes and agricultural fertilizers. High sulfate concentrations are often found in aquifers underlying current or historic agricultural lands, mining areas, and areas of natural mineralization.

The EPA has not established a primary MCL for sulfate although it is currently under review. The secondary MCL for sulfate is 250 mg/l. Figure 7-2 illustrates sulfate conditions in the Phoenix AMA. Elevated sulfate levels above the secondary MCL are prevalent in the West Phoenix area, Buckeye, and the East Salt River Valley Subbasin. Sulfate levels for raw CAP water are typically below the established secondary MCL.

Elevated sulfate concentrations in drinking water supplies can cause problems due to taste and laxative effects and can lead to scale formation in evaporative cooling systems. The diverse nature of industrial water requirements creates specific water quality needs for different industries. Some industries require very low sulfate levels while others can use water with elevated sulfate levels. Additionally, high sulfate concentrations in groundwater do not commonly limit agricultural water use.

### 7.5.4.3 Total Dissolved Solids

TDS content is a measure of the dissolved minerals present in water and is a general indication of water quality. Components of TDS include inorganic compounds such as calcium, magnesium, sodium, potassium, sulfate, bicarbonate, chloride, and silica. In most areas, the primary components of TDS are derived naturally as groundwater dissolves minerals present in aquifers. TDS concentrations can also be elevated by agriculture, industry, and wastewater treatment facility discharges.

The EPA has established an SMCL of 500 mg/l for TDS, primarily for aesthetic reasons. High TDS concentrations which result in scaling and mineral accumulation have been shown to have an adverse economic impact on water distribution systems and household plumbing and appliances. Though no permanent harmful effects have been observed from drinking high TDS water, some people may find the taste of this water to be less desirable than lower TDS water.

TDS concentrations in the Phoenix AMA are depicted in Figure 7-3. Groundwater within the Phoenix AMA exhibits TDS concentrations of up to 3,000 mg/l in the Buckeye area. Most groundwater in the Phoenix area contains TDS at concentrations of 500-1,000 mg/l, with concentrations decreasing with greater distance from the Phoenix metropolitan area. The highest concentrations are found near the Salt and Gila Rivers and in the West Salt River Valley Subbasin.

The concentration of TDS that limits water use varies widely among industries. A few industries (such as the semiconductor industry) require water so pure that they must treat almost any source water to obtain the necessary quality. Other industries, such as sand and gravel operations, can use water with very high TDS concentrations. The application of high TDS water on turf facilities can cause harmful effects to turf quality and to sprinkler heads if proper management techniques are not followed.

### 7.5.4.4 Metals

The EPA has established primary MCLs for the following nine metals that occur in drinking water: antimony, arsenic, barium, beryllium, cadmium, chromium, mercury, selenium, and thallium. High concentrations of metals are typically associated with industrial wastes, but certain metals may naturally occur in some aquifers.

Problems with metals are uncommon in the Phoenix AMA, though a few groundwater samples within the Phoenix AMA have exhibited metals concentrations in excess of MCLs. Figure 7-4 displays metal concentrations in the Phoenix AMA.

The health effects associated with exposure to metals vary depending on the constituent and concentrations. Some metals such as selenium and chromium are known to be essential for human nutrition and are beneficial in certain concentrations. Others, such as lead, have no known beneficial effects on human or animal development and are harmful in high concentrations. Limitations imposed on industrial and agricultural water use by high concentrations of metals vary considerably depending on the contaminant present and the associated use.

ADWR Third Management Plan
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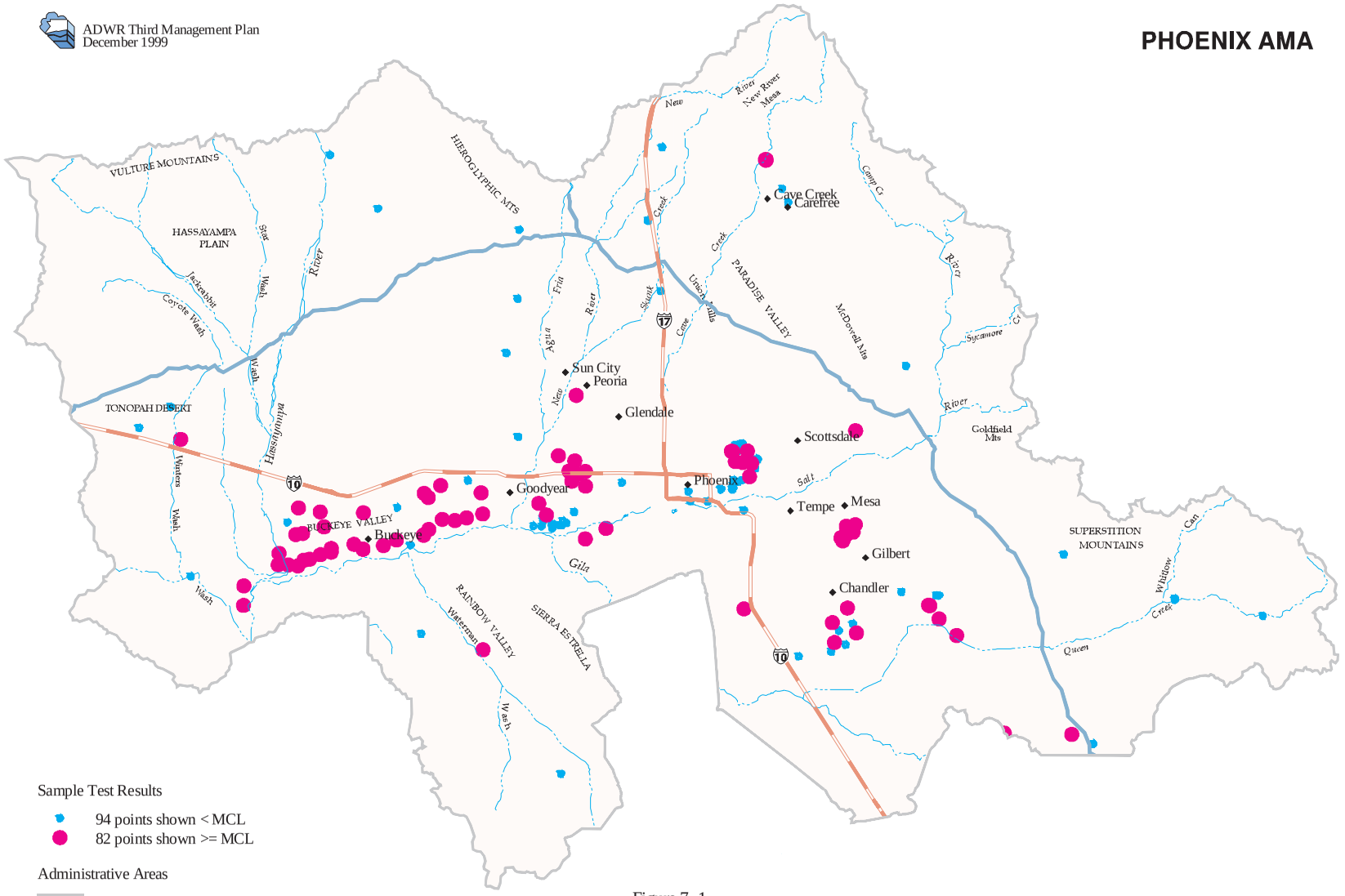
# PHOENIX AMA




Sample Test Results

- 94 points shown < MCL
- 82 points shown >= MCL

Administrative Areas

- Phoenix AMA
- Interstate Highways
- Streams
- CAP Aqueduct
- Cities

Figure 7- 1

## Water Quality Sample Test Results

Nitrate Nitrogen and Nitrite Plus Nitrate

0 3 6 9 12
Miles

North

ORIGINAL SOURCE

Arizona Dept of Environmental Quality:
Well Locations and Water Quality
Samples since 1990

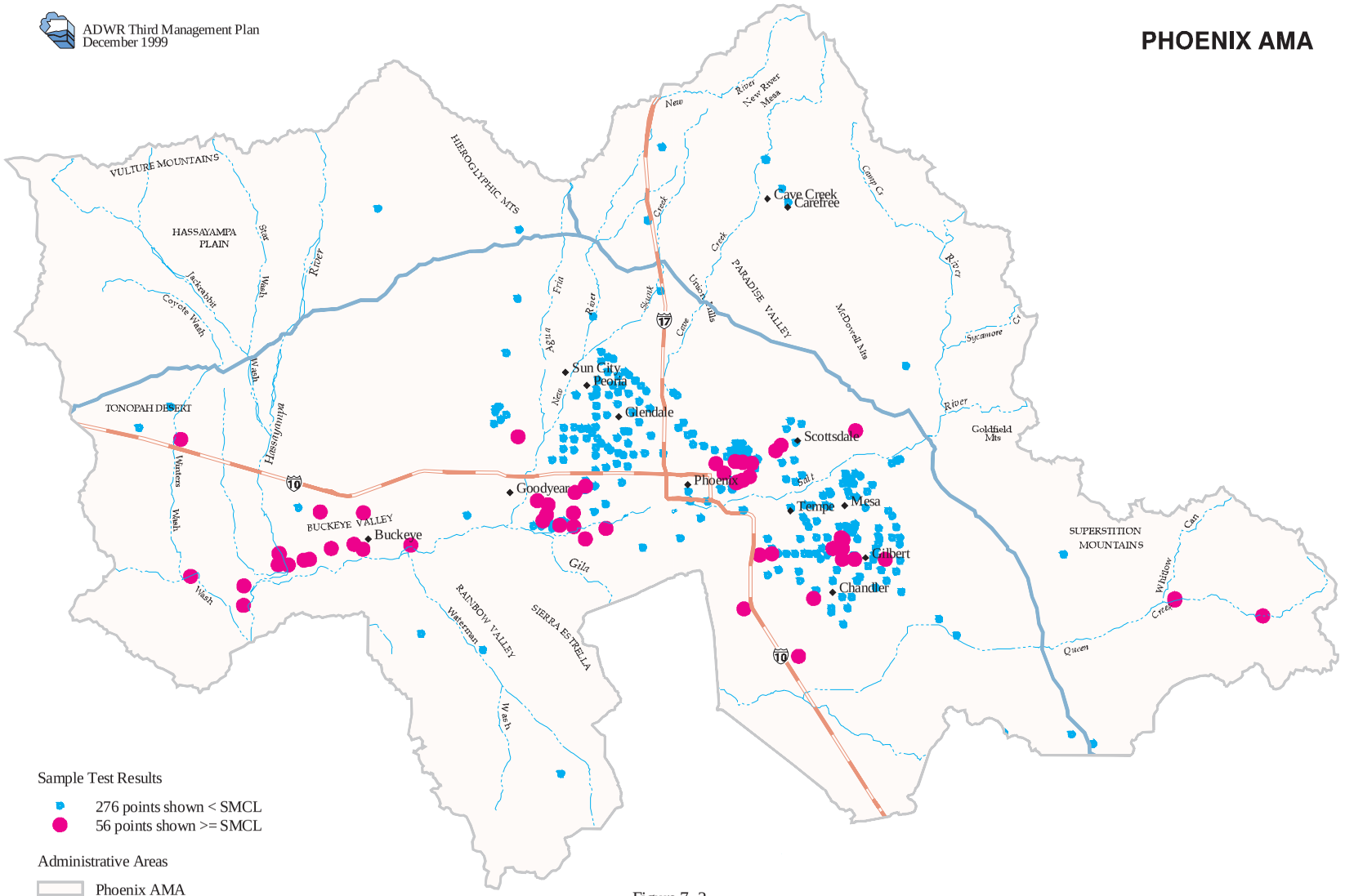



Figure 7- 2

# Water Quality Sample Test Results

## Sulfate

ORIGINAL SOURCE

Arizona Dept of Environmental Quality:
Well Locations and Water Quality
Samples since 1990

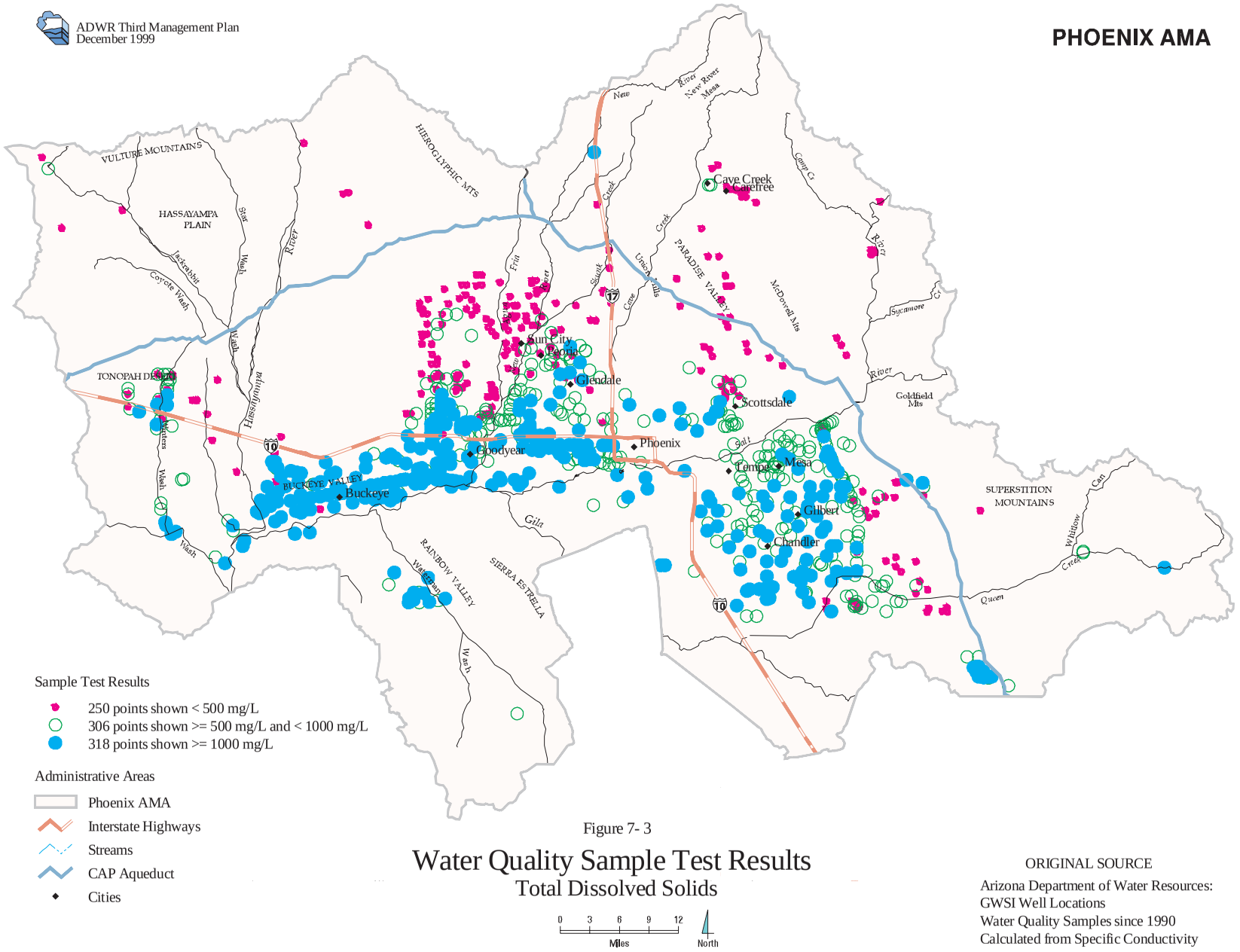



Figure 7- 3

# Water Quality Sample Test Results

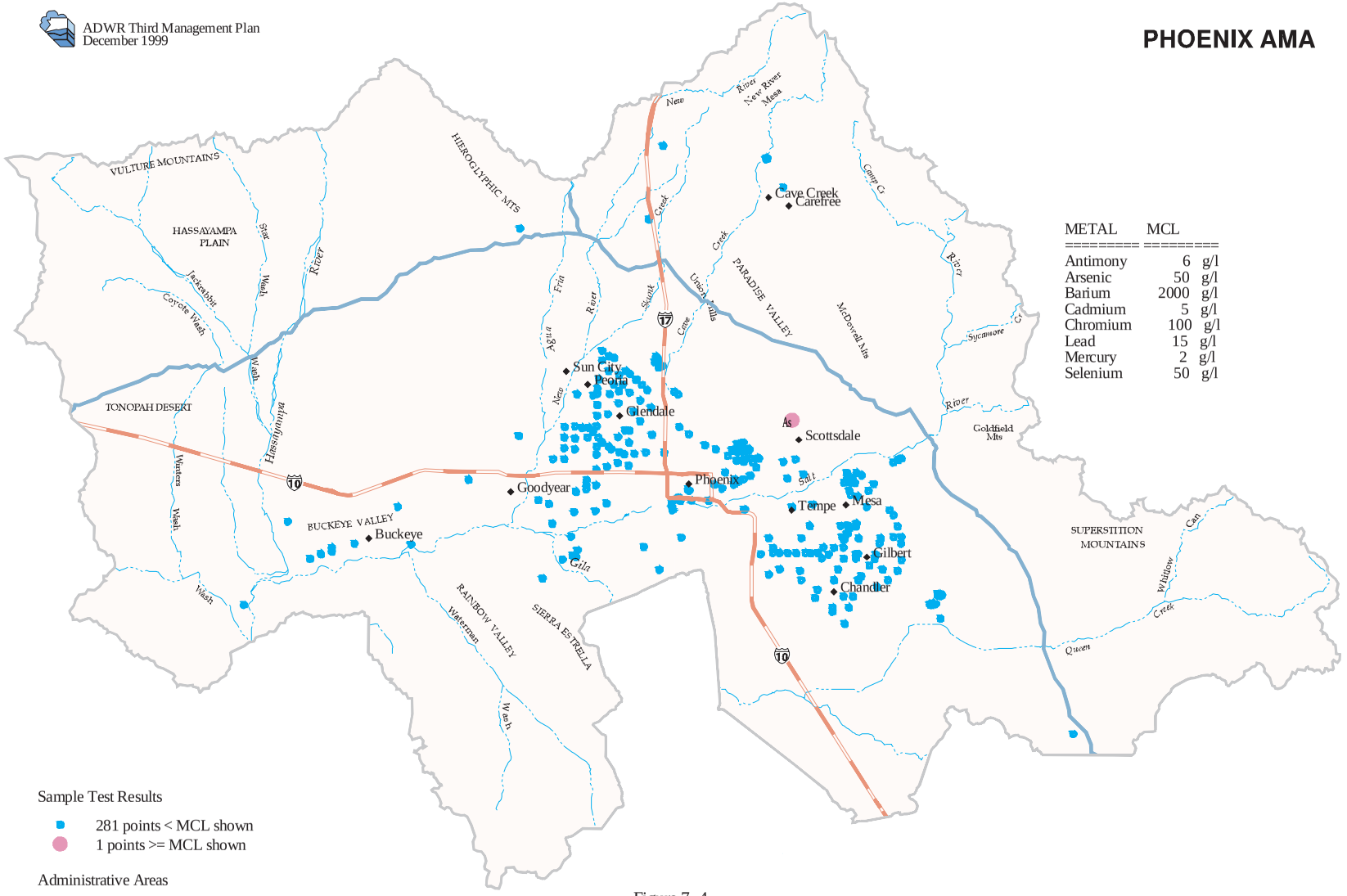
## Total Dissolved Solids

ORIGINAL SOURCE

Arizona Department of Water Resources:
GWSI Well Locations
Water Quality Samples since 1990
Calculated from Specific Conductivity

ADWR Third Management Plan
December 1999

# PHOENIX AMA




| METAL | MCL |
|---|---|
| Antimony | 6 g/l |
| Arsenic | 50 g/l |
| Barium | 2000 g/l |
| Cadmium | 5 g/l |
| Chromium | 100 g/l |
| Lead | 15 g/l |
| Mercury | 2 g/l |
| Selenium | 50 g/l |

Sample Test Results

- 281 points < MCL shown
- 1 points >= MCL shown

Administrative Areas

- Phoenix AMA
- Interstate Highways
- Streams
- CAP Aqueduct
- Cities

Figure 7- 4

## Water Quality Sample Test Results
### Metals

0 3 6 9 12
Miles

North

ORIGINAL SOURCE

Arizona Dept of Environmental Quality:
Well Locations and Water Quality
Samples since 1990

### 7.5.4.5 Volatile Organic Compounds

VOCs, such as trichloroethylene (TCE) and tetrachloroethylene (PCE), are chemicals that evaporate easily but do not readily dissolve in water. Other VOCs include acetone, vinyl chloride, 1,2-dichloroethane, benzene, 1,1-dichloroethylene, 1,1-dichloroethane, chloroform, toluene, and methylene chloride. VOCs are present in, or are used for the manufacturing of, many substances including degreasers, solvents, plastics, paint, varnish, finish removers, detergent, medicine, and gasoline. When found in groundwater, VOCs are usually associated with industrial areas, landfills, and other sites used for the improper disposal of chemicals.

VOCs are concentrated near WQARF and CERCLA sites in the Phoenix AMA, particularly in central Phoenix, south Scottsdale, north Tempe, near the Phoenix Goodyear Airport, and some other locations. Figure 7-5 displays VOC concentrations within the Phoenix AMA.

Health effects associated with VOCs in drinking water are complex and vary with the types of compounds and concentrations present. Some VOCs such as TCE, are suspected human carcinogens while others have been associated with damage to internal organs. Drinking water supplies which exceed MCLs for VOCs must be treated prior to use.

Potential industrial and agricultural applications of water containing VOCs must be examined on an individual basis.

### 7.5.4.6 Petroleum Hydrocarbons

This class of contaminants includes non-halogenated hydrocarbons such as benzene, toluene, ethylbenzene, and xylenes, which are ingredients of gasoline and other fuels. Geographical concentrations of these constituents are included as part of the VOC map displayed as Figure 7-5. MCLs have been established for the primary ingredients in gasoline and other fuels. These contaminants can affect groundwater as a result of, among other things, leaking USTs. According to ADEQ, there are over 5,700 leaking UST sites in Arizona. Only a small percentage of these sites are causing groundwater contamination, however. Petroleum hydrocarbons may naturally attenuate over time depending on the physical, chemical, and microbiological conditions in the aquifer.

In Maricopa County, approximately 1,250 open leaking UST facilities were identified out of a total of about 1650 registered open UST facilities. Most of these sites are located within the Phoenix AMA. Some of these leaking USTs have affected groundwater quality. The probable source of contamination at most of these locations is leaking tanks associated with gasoline stations, commercial, and industrial sites. The sites identified have varying degrees of groundwater contamination and are in various stages of remediation. Petroleum hydrocarbon information is not specifically represented on a water quality map in this chapter, although the VOC groundwater quality map encompasses this information indirectly.

### 7.5.4.7 Pesticides

Pesticides are synthetic organic chemicals which are used as insecticides, rodenticides, and herbicides. Pesticides can be detected in groundwater underlying areas irrigated for citrus. The now banned citrus nematocides ethylene dibromide (EDB) and dibromochloropropane (DBCP) have been detected in groundwater in some areas in the Phoenix AMA, particularly in the West Salt River Valley and the Buckeye area. Figure 7-6 shows pesticide concentrations within the Phoenix AMA. The pesticides EDB and DBCP are the only pesticides which cause major groundwater quality management problems in the Phoenix AMA.

ADWR Third Management Plan
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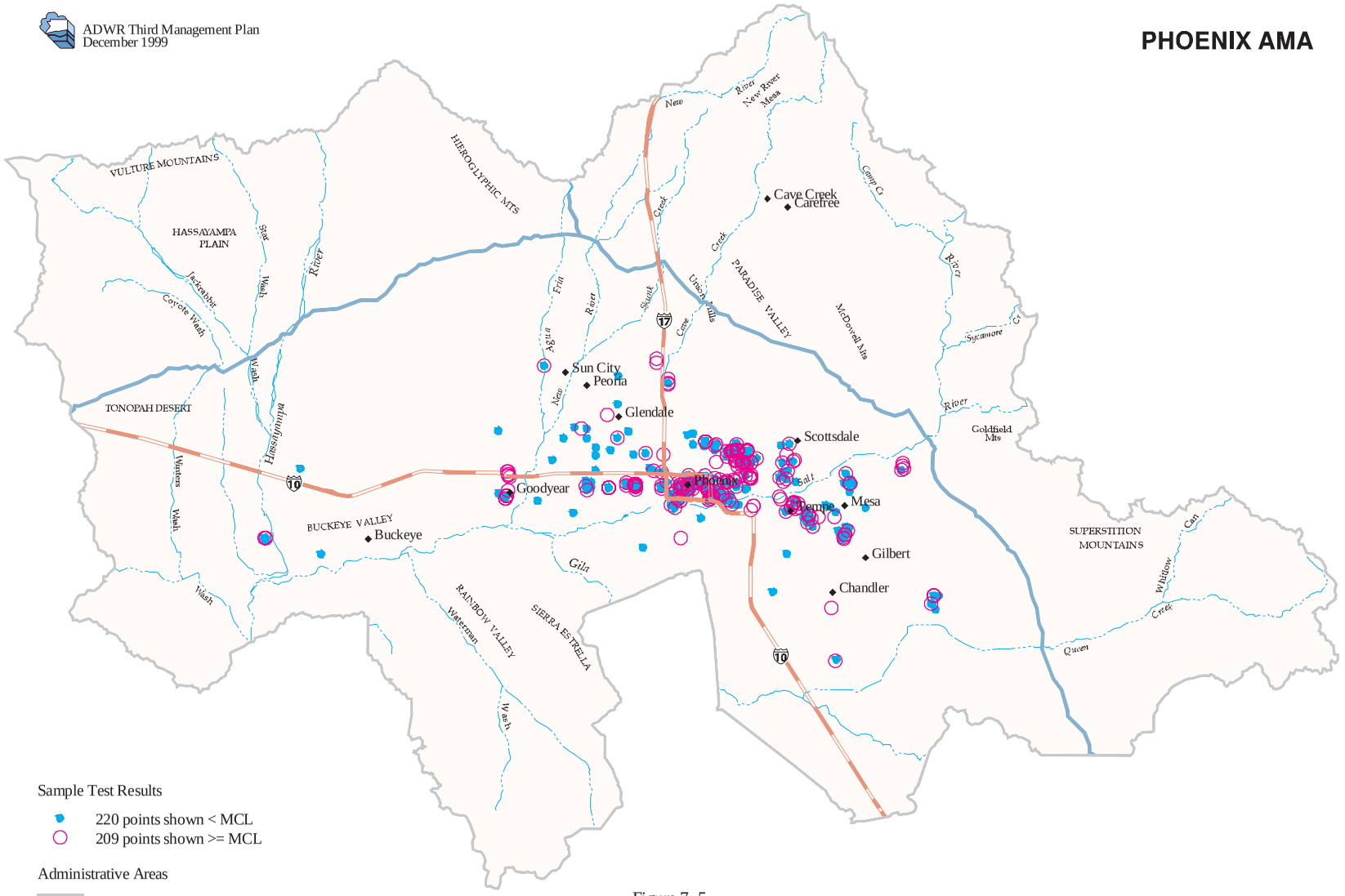
# PHOENIX AMA




Sample Test Results

- 220 points shown < MCL
- 209 points shown >= MCL

Administrative Areas

- Phoenix AMA
- Interstate Highways
- CAP Aqueduct
- Streams
- Cities

Figure 7- 5

## Water Quality Sample Test Results
### Volatile Organic Compounds

0 3 6 9 12
Miles

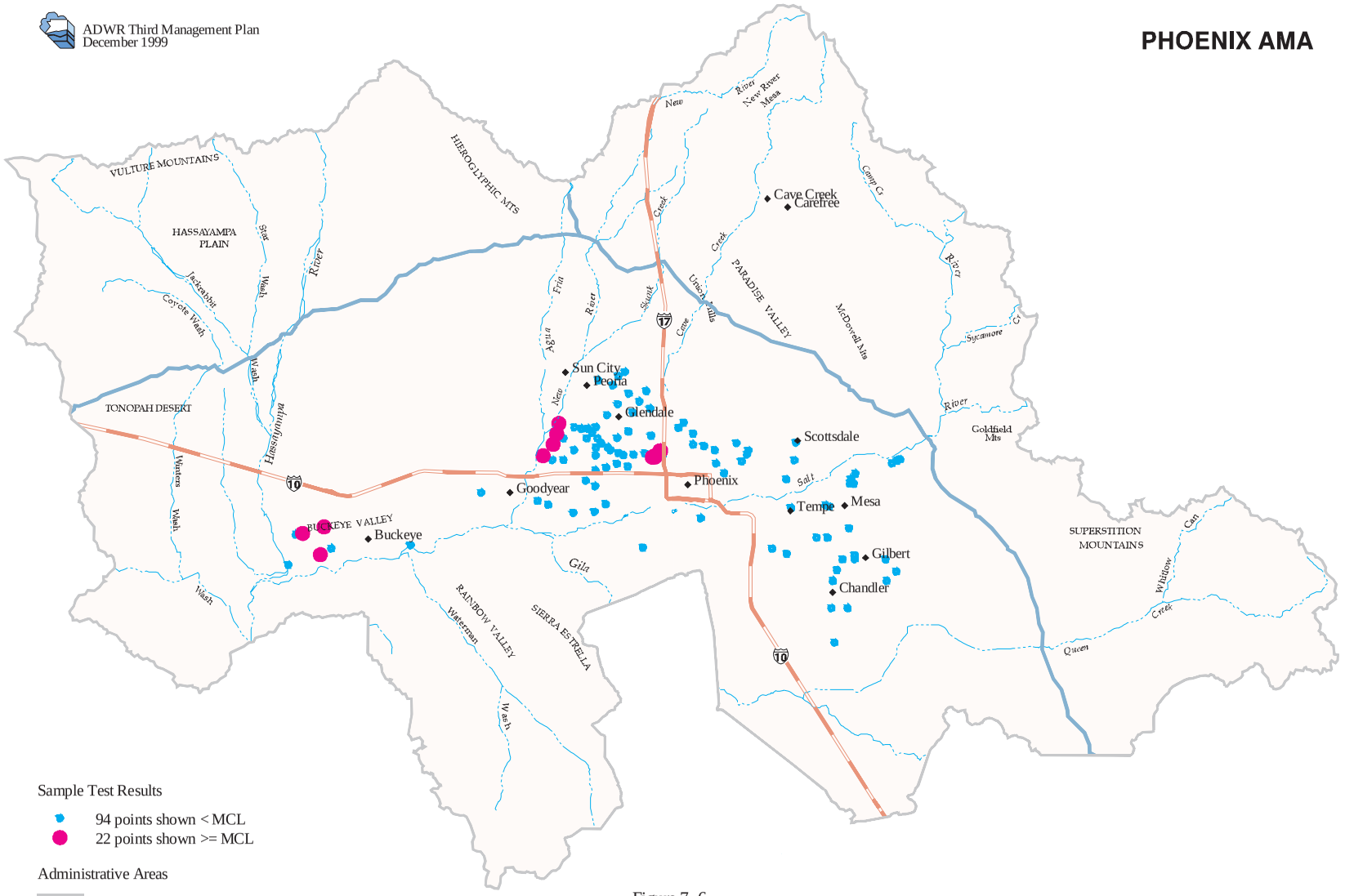
North

ORIGINAL SOURCE

Arizona Department of Water Resources:
Registered Well Locations
Arizona Dept of Environmental Quality:
Water Quality Samples since 1990

ADWR Third Management Plan
December 1999

# PHOENIX AMA




Sample Test Results

- 94 points shown < MCL
- 22 points shown >= MCL

Administrative Areas

- Phoenix AMA
- Interstate Highways
- CAP Aqueduct
- Streams
- Cities

Figure 7- 6

## Water Quality Sample Test Results
### Pesticides

0 3 6 9 12
Miles

North

ORIGINAL SOURCE

Arizona Dept of Environmental Quality:
Well Locations and Water Quality
Samples since 1990

One of the best known pesticides is the chemical compound 1,1,1-trichloro-2,2-bis (p-chlorophenyl)ethane, otherwise known as DDT. DDT is a water-insoluble compound that has a long residual life. DDT was used extensively until it was banned in 1973.

The health effects of pesticide exposure in water are varied and complex, depending on both the pesticide's inert and active ingredients and reaction with substances contained in the water. Drinking water supplies can be affected by pesticide contamination. The presence of pesticides can restrict some industrial water uses such as animal-based industries, because elevated concentrations of pesticides may bioaccumulate (accumulate in living tissue) as they are passed through the food chain. Pesticides that are used for agriculture can also bioaccumulate, thus restricting the use of particular chemicals on edible crops.

#### 7.5.4.8 Fluoride

Fluorides are compounds found in rocks and soil and some industrial waste products. Fluorides are used primarily in manufacturing and as a drinking water additive for the prevention of tooth decay. Fluoride occurs naturally in groundwater, however, its potential for domestic or municipal use depends on the concentration level. Elevated concentrations can cause mottling of teeth and skeletal effects. The EPA primary MCL for fluoride is 4.0 mg/l and the recommended SMCL is 2.0 in order to prevent mottling of teeth.

Concentrations of fluoride in excess of the MCL are found in some areas of the AMA, including east Phoenix, the Hassayampa Subbasin, and other areas. Fluoride concentrations in the Phoenix AMA are shown in Figure 7-7.

#### 7.5.4.9 Radiochemicals

Radioactive elements such as uranium, radon, and radium occur naturally in soil and water at locations throughout Arizona. The federally proposed MCL level for radon is 300 picocuries per liter (pCi/l), but radon in groundwater is not regulated. The EPA is currently collecting data on radon occurrences and conducting a health affects study prior to promulgating a radon standard for drinking water. Inhalation of radon may be harmful when it is released to the air from a contaminated water source. The primary concern of using radon-contaminated water is to ensure that the release of emissions are below air quality standards when processes such as cooling towers, construction aggregate washing and sprinkler irrigation are used.

Due to the lack of available data, groundwater quality maps depicting radiochemical concentrations were not produced for this chapter. Several radioactive elements occur naturally in soil and water. Uranium mining activities which include waste dumps and mine tailings, as well as mine dewatering, can contaminate groundwater with radiochemicals.

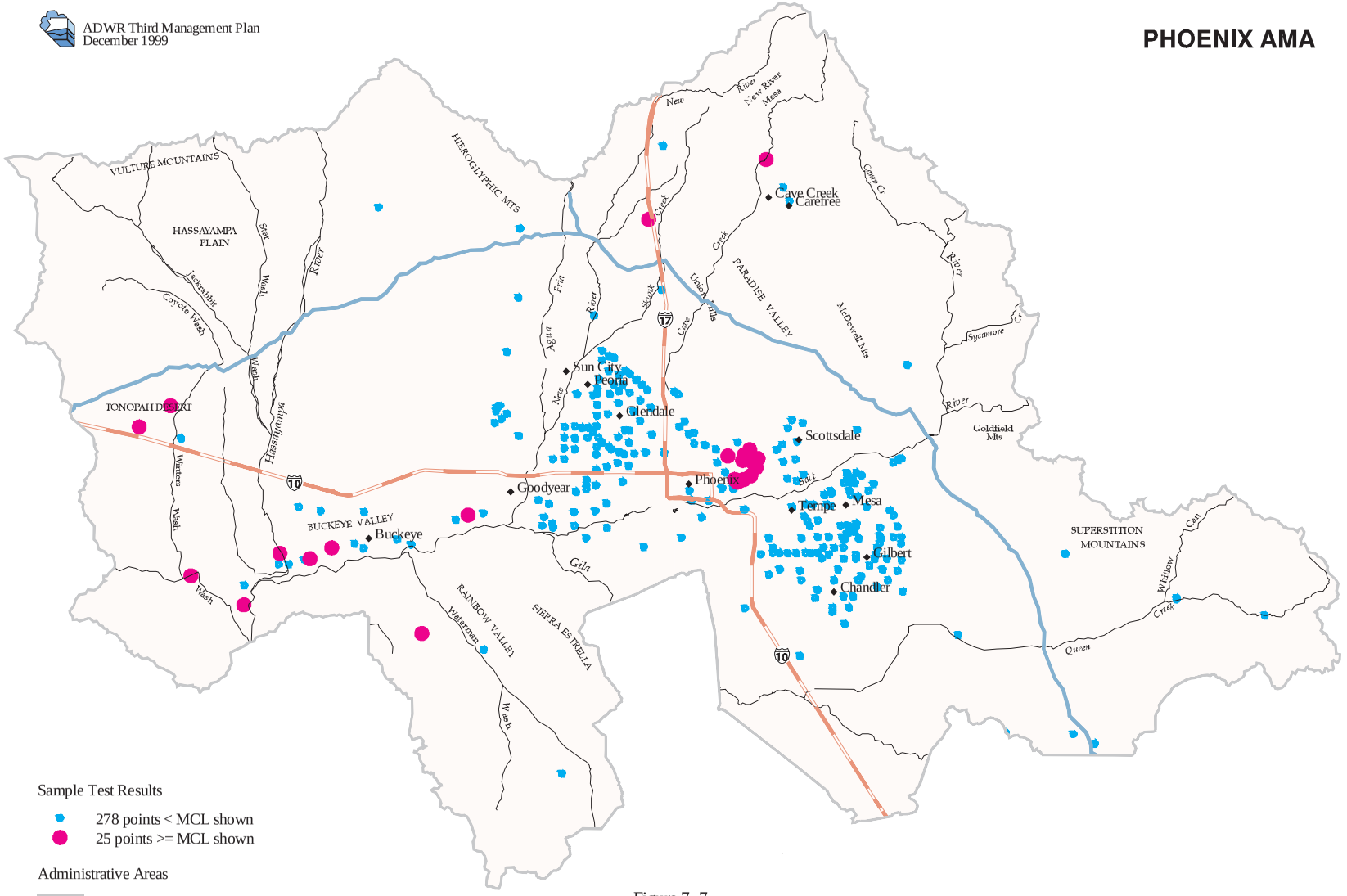
In the Phoenix AMA, naturally occurring contaminants such as radon affect groundwater in some areas which are generally located near hardrock formations.

### 7.5.5 Specific Contamination Areas

This section contains a description of the specific groundwater contamination areas which have been identified in the Phoenix AMA. Unless otherwise indicated, each of these sites are listed on the WQARF Priority List or the NPL. Figure 7-8 shows existing WQARF, CERCLA, or Department of Defense remedial site boundaries located within the Phoenix AMA. A summary of individual remedial sites in the Phoenix AMA are provided below. The status of each remedial site was obtained from the WQARF Quarterly Report submitted to the state Joint Legislative Budget Committee by the ADEQ for the period of July 1, 1997 through March 31, 1998.

ADWR Third Management Plan
December 1999

# PHOENIX AMA




Sample Test Results

- 278 points < MCL shown
- 25 points >= MCL shown

Administrative Areas

- Phoenix AMA
- Interstate Highways
- CAP Aqueduct
- Streams
- Cities

Figure 7- 7

## Water Quality Sample Test Results
### Fluoride

0 3 6 9 12
Miles

North

ORIGINAL SOURCE

Arizona Dept of Environmental Quality:
Well Locations and Water Quality
Samples since 1990

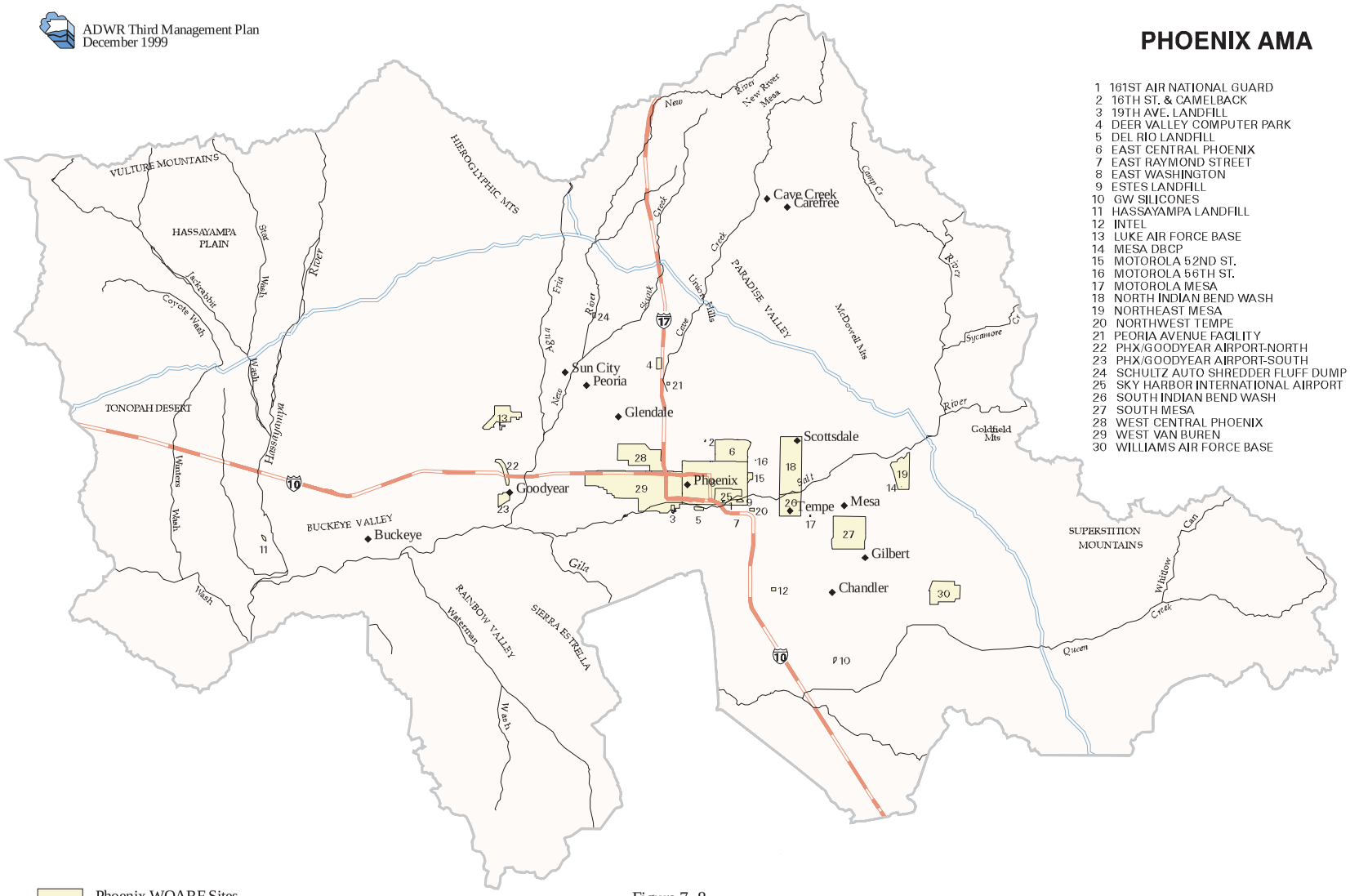



Figure 7- 8

# Water Quality Study Areas

ORIGINAL SOURCE

Arizona Dept of Environmental Quality
Geographic Information System

#### 7.5.5.1 Mesa DBCP WQARF Site

This site is located in northeast Mesa and exhibits groundwater contamination from the citrus nematocide DBCP. Concentrations of 0.05-0.93$\mu$g/l are present. This project is a treatment facility on one of the wells owned by the City of Mesa. The treatment facility uses carbon beds to absorb the DBCP from the well water. The City is looking to alternatives to reduce operational costs. The well is only in standby service.

#### 7.5.5.2 Northeast Mesa WQARF Site

This site is located in northeast Mesa and exhibits TCE contamination at approximately 64 $\mu$g/l in two wells. The extent of contamination is not yet fully defined. The WQARF Site Registry Report and map were completed. The first groundwater sampling round to include all three new monitoring wells was conducted by the ADEQ in February 1998. Wellhead monitoring is planned for the duration of well usage. Additional remedial action may be necessary if monitoring results so indicate.

#### 7.5.5.3 South Mesa WQARF Site

Groundwater at this site contains VOCs. PCE has been found at approximately 40 $\mu$g/l. The size of the groundwater contamination plume is not yet fully defined. Wellhead treatment and an additional well are planned. Wellhead treatment is underway as a groundwater cleanup remedy. PCE concentrations in the groundwater have dropped below discharge limitations, thus allowing disconnection of the groundwater treatment system at Baseline Road and Mesa Drive. Quarterly groundwater sampling including eight downtown Mesa areas continues.

#### 7.5.5.4 East Washington WQARF Site

This site is located in east Phoenix and exhibits groundwater contamination from VOCs, particularly TCE, PCE, and DCE. Concentrations are in the 300-600 $\mu$g/l range in the northern part of this site. A groundwater data task was completed by an ADEQ contractor in September 1997. A task assignment for Central Phoenix groundwater flow modeling was also initiated in September. Significant work has occurred on the Central Phoenix Groundwater Plume model including sampling of 75 wells, meetings with consultants, and document submittals. The ADEQ is continuing its work to identify potentially responsible parties. Monitoring and investigation is currently ongoing to compile further information to evaluate the site. Plume management, funded by the ADEQ and interested parties, is anticipated to be the planned remedial action.

#### 7.5.5.5 Sky Harbor WQARF Site

Groundwater is contaminated with VOCs at this site near Sky Harbor International Airport in Phoenix. The extent of contamination is not fully defined. The ADEQ is coordinating the groundwater monitoring program of this site as part of the East Washington Area.

#### 7.5.5.6 Estes Landfill WQARF Site

This site is located in Phoenix near Sky Harbor International Airport. Groundwater is contaminated with VOCs, including vinyl chloride, TCE, and DCE. Total VOCs concentrations are as high as 13,057$\mu$g/l. Investigations at this site are ongoing. Groundwater in this area has been impacted by VOCs. It appears that a major source of contamination exists in the south-central portion of the Estes Landfill. Quarterly monitoring of groundwater is conducted by the City of Phoenix and the ADEQ. The City completed the remedial investigation and submitted a draft to the ADEQ for review in September 1997. The final remedial investigation and feasibility study (RI/FS) report is expected by March 1999.

#### 7.5.5.7 West Van Buren WQARF Site

This site is located in west Phoenix and is characterized by groundwater contamination by VOCs and metals. Chromium concentrations of 7,000 $\mu$g/l and TCE and PCE concentrations in excess of 1,500 $\mu$g/l are present. Monthly groundwater elevation data are being collected from approximately 30 wells in the East Washington/West Van Buren site area.

Contracts were awarded for additional investigation activities at the ALSCO site. Drilling of three monitor wells began in March 1998. This site is also encompassed within the Central Phoenix groundwater flow model.

#### 7.5.5.8 East Central Phoenix WQARF Site

This site is located in east Phoenix. Groundwater is contaminated by VOCs, including PCE, TCE, and TCA. PCE concentrations of up to 34,000 $\mu$g/l have been detected. The ADEQ installed a soil vapor extraction system as an interim remedy at a dry-cleaning facility to minimize the migration of the PCE contamination from the soils to the groundwater. The system has been temporarily shut down due to negotiations for access to private properties. Soil vapor extraction and groundwater pump and treat are the remedial actions likely to occur at this site. This work will be funded by the ADEQ.

#### 7.5.5.9 West Central Phoenix WQARF Site

This site has been contaminated by VOCs from multiple sources, including PCE in concentrations as high as 95,000 $\mu$g/l. The West Osborn Complex Phase II RI/FS Workplan is still being implemented. Groundwater monitoring and water level measurements were collected from all wells. The site is in the process of being split into at least five separate sites which will be placed on the Site Registry after April 1998. Groundwater pump and treat is planned for the final cleanup remedial action.

#### 7.5.5.10 Northwest Tempe WQARF Site

Groundwater at this site, which is located northeast of the Interstate 10/Arizona 143 interchange, exhibits contamination from VOCs, particularly 1,1-DCE. Concentrations of over 60 $\mu$g/l have been observed. Investigations to establish contaminant distribution are ongoing. Groundwater pump and treat will be evaluated after sources of contamination are identified.

#### 7.5.5.11 Motorola 52nd Street CERCLA Site

This site is located in east Phoenix and is characterized by groundwater contamination by VOCs, including TCA (up to 5,100 $\mu$g/l), TCE, and other contaminants. A partial groundwater remedy has been implemented, and a second remedy is planned. The Operable Unit 1 groundwater pump and treat system is operational. An estimated 550 gallons of contaminated groundwater is being remediated per minute. The Operable Unit 2 remedial design is 30 percent complete.

#### 7.5.5.12 Motorola 56th Street Site

This site is located in east Phoenix near 56th Street and Thomas Road. A plume of contaminated groundwater extends to approximately 42nd Street and Thomas Road. TCE concentrations of up to 1,600 $\mu$g/l have been detected. Monitoring efforts are ongoing, with 100 groundwater quality samples taken by the ADEQ from July 1997 through March 1998.

#### 7.5.5.13 Motorola Mesa Site

A groundwater contamination plume has been identified at this site at Broadway Road and Dobson Road in Mesa. Groundwater is contaminated with VOCs, most notably PCE and TCE, in concentrations of up to approximately 45 $\mu$g/l. Extraction and treatment of contaminated groundwater has been ongoing since 1984.

#### 7.5.5.14 North Indian Bend Wash CERCLA Site

This site is located in south Scottsdale and exhibits groundwater contamination from VOCs, particularly TCE. Concentrations are generally in the 100-500 $\mu$g/l range. A groundwater remedy consisting of treatment of contaminated water and distribution in the Scottsdale municipal system has been implemented. A second remedial action, consisting of a central treatment plant for the Paradise Valley Water Company, was implemented in 1996. Additional groundwater source control projects are being studied and will be implemented in the near future.

#### 7.5.5.15 19th Avenue Landfill CERCLA Site

This site is located in west Phoenix on the Salt River banks. Groundwater contamination above MCLs has been detected for vinyl chloride, TCE, DCE, and PCE. A monitoring program and contingency plan have been implemented for the site.

#### 7.5.5.16 Williams Air Force Base CERCLA Site

This site is located in far southeast Mesa. Jet fuel from underground storage tanks has contaminated groundwater. Although the base closed in 1993, remedial actions continue at the site.

#### 7.5.5.17 Phoenix Goodyear Airport CERCLA Site

This site, which is located in Goodyear, exhibits contamination from VOCs, including TCE, DCE, and methyl ethyl ketone at concentrations over 500 $\mu$g/l. This site has been divided into two parts, north and south. Remedial actions at the south part of the site consist of groundwater withdrawals, treatment to remove contaminants, and reinjection. Remedial action at the north site consists of groundwater withdrawals, treatment to remove contaminants, and non-potable use.

#### 7.5.5.18 Hassayampa Landfill CERCLA Site

This site is located near Hassayampa, west of the Phoenix metro area. Groundwater is contaminated with VOCs, including DCE, TCA, Freon, and PCE. Total VOC concentrations are as high as 1,359 $\mu$g/l. A groundwater remedy has been implemented at this site.

#### 7.5.5.19 Deer Valley Computer Park Site

This site is located in northwest Phoenix near Thunderbird Road and Interstate 17. Elevated concentrations of VOCs, including TCE (1.5 to 1,250 $\mu$g/l), have been detected in groundwater. Remedial actions consist of pumpage, treatment, and re-injection.

#### 7.5.5.20 Honeywell-Peoria Site

This site is located in northwest Phoenix on Peoria Avenue east of Interstate 17. Groundwater contamination from VOCs in the 55 to 59,000 $\mu$g/l range has been detected. A groundwater remedy consisting of withdrawal, treatment, and re-injection is projected to be implemented by 1998 or 1999.

#### 7.5.5.21 Great Western Silicones Site

This site is located in south Chandler, east of Interstate 10. Groundwater is contaminated with VOCs, including DCE, PCE, and Freon-113. PCE has been detected at concentrations up to 17.8 $\mu$g/l. A groundwater remedy has been implemented. Remediated groundwater is used for landscape and crop irrigation.

#### 7.5.5.22 16th Street and Camelback Site

This site is located in east Phoenix and exhibits groundwater contamination from VOCs. PCE has been detected at 252 $\mu$g/l and 1,2-dichloroethane has been detected at 120 $\mu$g/l. ADEQ has installed monitoring wells and is planning additional investigations at this site.

#### 7.5.5.23 Glendale Avenue Landfill Site

This site comprises 320 acres and is located just east of the Agua Fria River between Glendale and Northern Avenues. Groundwater in the area has been found to be contaminated with chromium, arsenic, and nitrate. Groundwater is monitored quarterly.

#### 7.5.5.24 Capitol Castings Site

This site is located on south Kyrene Road in Tempe. Groundwater is contaminated above MCLs with VOCs (including 1,1-dichloroethylene and 1,2-dichloroethane), and petroleum hydrocarbons.

#### 7.5.5.25 Del Rio Landfill Site

This site, located near the Salt River and 16th Street in Phoenix, is being voluntarily investigated by the City of Phoenix.

## 7.6 SUMMARY

Most groundwater supplies in the Phoenix AMA are of acceptable quality for most uses. However, human activity and natural processes have resulted in the degradation of groundwater quality in some areas to the extent that it is unusable for many purposes. The extent and type of contamination varies by location and land use activities. In general, contaminated groundwater has afflicted the upper aquifers throughout a large part of the Phoenix AMA with dissolved solids, nitrates, and other contaminants. Waterlogging down gradient of Phoenix has required drainage pumpage of groundwater with high concentrations of TDS. Pumpage centers that provide potable water can and do influence the migration of poor quality water in many areas of the AMA. The WQARF sites identified in the Phoenix AMA are in varying stages of development, from remedial investigations to actual site cleanup.

As WQARF activities progress, addressing water management issues such as available supply and reuse options will become essential to ensure a long-term water supply of adequate quality. The ability to recognize specific groundwater management requirements for contaminated and degraded aquifer conditions will also become increasingly important as the demands for water increase.

During the first and second management periods, the ADEQ emphasized pump and treat remedies to cleanup poor quality groundwater in aquifers within the AMA. Success was limited, however, due to lengthy periods of litigation which have seriously restricted actual cleanup activities. With the advent of the WQARF reform package of 1997, a new approach emphasizing incentives to cleanup and flexibility in the selection of remedies was developed to improve the likelihood that sites will actually become remediated.

The 1997 WQARF reform legislation creates an incentive for the use of groundwater withdrawn in accordance with approved remedial action projects pursuant to Title 49, Arizona Revised Statutes, or CERCLA. It provides that such groundwater must be accounted for consistent with accounting for surface water for purposes of determining compliance with management plan conservation requirements and that the use of certain volumes of such groundwater is consistent with achievement of the management goal of the AMA until the year 2025. During the third management period, the Department will amend its Assured Water Supply Rules to conform to these provisions. Additionally, permanent rules regarding well spacing and impact will be promulgated by the Department during the third management period. The Department also intends to integrate water quality concerns more fully into its underground water storage programs.

During the third management period, the Department will be committed to enacting and implementing the provisions outlined in this chapter. This commitment will encompass several new provisions and activities summarized below.

- An ongoing groundwater quality assessment in cooperation with ADEQ will assist with the evaluation of existing rules and provisions.

- Integration of groundwater quality management into recharge planning and permitting, and the development of incentives to use remediated groundwater where appropriate.

- Formal permit coordination with ADEQ in order to cooperate on both Title 45 and Title 49 permits. Basin-wide or non-site-specific tracking and coordination of all permits will provide both agencies with a more complete picture of contaminant distribution, groundwater withdrawals, and releases to groundwater and surface water on a basin-scale perspective.

- Evaluation of the need for additional incentives to withdraw and use remediated groundwater within the AMAs throughout the third management period in an effort to match quality with beneficial use. This evaluation will include groundwater that may be contaminated with hazardous, non-hazardous, and naturally occurring substances. Incentives may involve amendments to Arizona Revised Statutes, Title 45, Department rules and policies, or a modification of the management plans.

- The Department and ADEQ will develop and enter into Memorandums of Understanding as necessary to establish, among other things, the division of responsibilities for the implementation of the reformed WQARF program, development of common scopes of work for WQARF sites and other groundwater contamination sites, as well as database development and exchange.

The Department's Water Quality Section, which was established with funding provided by the 1997 WQARF reform legislation, will allow the Department to strengthen its commitment to work closely with ADEQ to resolve groundwater quantity and quality issues. Monies committed by the WQARF reform bill will expedite the cleanup of remedial sites.

Other remedial activities such as those associated with Superfund sites will continue to include the Department's direct involvement. This will ensure that remedial activities meet the Department's water management objectives and are consistent with the AMA's safe-yield goal.

## 7.7 FUTURE DIRECTIONS

The Department's long range plans for groundwater quality management will focus on two areas: (1) evaluation of groundwater quality issues on a non-site-specific level in order to understand the impact of

groundwater quality issues on water resource management on a broader level and (2) preservation of AMA management goals with emphasis on implementing incentives to use remediated groundwater.

### 7.7.1 Non-Site-Specific Water Quality Management

Non-site-specific groundwater quality management refers to groundwater quality management activities which may occur in general areas located outside of an identified WQARF or CERCLA boundary.

Significant volumes of groundwater in Arizona have been contaminated or degraded to varying degrees due to human activities. Groundwater contaminated with substances such as nitrate, sulfate, and dissolved solids (major cations and anions) generally result from non-point source pollution and can cause significant service problems for water providers and other water users. For example, groundwater containing high concentrations of TDS can cause scaling problems in cooling towers, is unsuitable for use on some crops, and can cause aesthetic problems in drinking water.

The cessation or decrease of groundwater withdrawals in some areas due to groundwater quality concerns can cause water tables to rise, exposing groundwater to contaminated soils or plume migration to other wells. For example, this condition can exist when soil contaminated by a leaking underground storage tank comes in contact with rising groundwater levels. Contaminated soils associated with landfills may also be inundated by rising water tables. These conditions need to be monitored for impacts on groundwater quality. Ultimately, proper planning will ensure that the impacts of groundwater recharge projects do not contribute to the degradation of aquifer conditions.

To address and mitigate dispersed contamination over large areas, a broader management strategy is needed. Areas which may need more intensive management can include those where public supply wells have been or may be affected by contamination. For instance, areas that are in the vicinity of major population centers or agricultural areas can be affected by contamination, especially if large volumes of groundwater are pumped, creating cones of depression.

The concept of groundwater quality management on a non-site-specific scale (general areas outside of identified site boundaries) will be developed to enhance water management activities in critical areas. The identification of source groundwater quality and the development of area-specific plans to match groundwater quality with the intended use will become an important aspect in the third management period. The Department intends to study the development of area-specific plans that could employ a combination of strategies to evaluate and mitigate the effects of contamination in critical areas. These plans should be developed in coordination with ADEQ and with affected stakeholders. Any contaminant management on a non-site-specific scale will be voluntary and will not affect rights to groundwater, well ownership, delivery responsibilities, or existing permits.

### 7.7.2 Preservation of AMA Management Goals

The WQARF reform package of 1997 was designed to encourage the remediation of groundwater that has limited or no use due to contamination. Pump and treat groundwater remediation activities are anticipated to increase substantially during the third management period as a result of the remediated groundwater use incentives provided in the WQARF reform package. As a result, previously unavailable sources of groundwater from contaminated areas may be put to considerable use.

Remediated groundwater withdrawals associated with WQARF, CERCLA, Department of Defense, RCRA, and voluntary site cleanups are expected to increase. According to estimates by the ADEQ, significant volumes of poor quality groundwater are projected to be remediated and subsequently withdrawn for beneficial use during the third management period within the Phoenix AMA. Depending on dates of implementation and other factors, estimates for withdrawals of remediated groundwater range

from roughly 75,000 acre-feet to 175,000 acre-feet annually. This estimate may be conservative because remedial activities on known contaminated areas are in different stages of development and due to the potential detection of unknown sites. Other estimates are provided in the Clean Sites West Study available at ADEQ.

In the third management period, the Department will monitor water levels, subsidence, and effects on local water providers at remedial project sites in areas of intensive pumping, which generally are concentrated within the major urban centers of Arizona. While the Department supports the remediation of contaminated groundwater, it also seeks to preserve the management goals of each AMA, of which the most predominant theme is the concept of safe-yield. Water quality management is a lengthy process which will likely continue far beyond the scope of the third management period. Continued remedial activities over the long-term will likely result in considerable volumes of groundwater being pumped, treated, and subsequently used.

The net effect of continued remediated groundwater withdrawals could result in a substantial increase in the overall volume of groundwater put to use within an AMA. Without proper coordination in both water resource and groundwater quality management, these actions could seriously jeopardize the goal of safe-yield by creating new groundwater uses. Remediated groundwater does not represent a renewable water supply. There are limited supplies of poor quality groundwater as well as groundwater of acceptable quality. Consequently, the Department will seek to preserve the intent of the Code and the AMA management goals to protect water resources while cooperating with ADEQ to promote groundwater quality management.

## APPENDIX 7A
## DRINKING WATER STANDARDS AND HEALTH EFFECTS
## PHOENIX ACTIVE MANAGEMENT AREA

| Contaminants | Primary MCL (mg/l)[1] | Potential Health Effects from Ingestion of Water | Sources of Contaminants in Drinking Water |
|---|---|---|---|
| **Inorganics** | | | |
| Antimony | 0.006 | Cancer | Fire retardants, ceramics, electronics, fireworks, solder |
| Arsenic | 0.05 | Skin, nervous system toxicity | Natural deposits; smelters, glass, electronics waste |
| Asbestos | 7.0 MFL[2] | Cancer | Natural deposits, asbestos cement in water systems |
| Barium | 2.0 | Circulatory system effects | Natural deposits, pigments, epoxy sealants, spent coal |
| Beryllium | 0.004 | Bone, lung damage | Electrical, aerospace, defense industries |
| Cadmium | 0.005 | Kidney effects | Galvanized pipe corrosion; natural deposits, batteries, paints |
| Chromium (total) | 0.1 | Liver, kidney, circulatory disorders | Natural deposits; mining, electroplating, pigments |
| Cyanide (as free cyanide) | 0.2 | Thyroid, nervous system damage | Electroplating, steel, plastics, mining, fertilizer |
| Fluoride[3] | 4.0 | Skeletal and dental fluorosis | Natural deposits, fertilizer, aluminum industries |
| Mercury | 0.002 | Kidney, nervous system disorders | Crop runoff; natural deposits; batteries, electrical switches |
| Nickel | Remanded | Gastrointestinal distress, skin irritation, respiratory congestion | Food, water, metal alloys |
| Nitrate (as N) | 10.0 | Methemoglobulinemia | Animal waste, fertilizer, sewage natural deposits, septic tanks |
| Nitrite (as N) | 1.0 | Methemoglobulinemia | Same as nitrate; rapidly converted to nitrate |
| Total nitrate/nitrite | 10.0 | Methemoglobulinemia | Animal waste, fertilizer, sewage natural deposits, septic tanks |
| Selenium | 0.05 | Liver Damage | Natural deposits; mining, smelting, coal/oil combustion |
| Thallium | 0.002 | Kidney, liver, brain, intestinal | Electronics, drugs, alloys, glass |

## APPENDIX 7A
## DRINKING WATER STANDARDS AND HEALTH EFFECTS
## PHOENIX ACTIVE MANAGEMENT AREA

| Contaminants | Primary MCL (mg/l)[1] | Potential Health Effects from Ingestion of Water | Sources of Contaminants in Drinking Water |
|---|---|---|---|
| **Volatile Organic Chemicals** | | | |
| Benzene | 0.005 | Cancer | Some foods; gas, drugs, paint, pesticides, plastic industries |
| Carbon tetrachloride | 0.005 | Cancer | Solvents and degradation by-products |
| ortho-Dichlorobenzene | 0.6 | Liver, kidney, blood cell damage | Paints, dyes, engine cleaning compounds, chemical wastes |
| para-Dichlorobenzene | 0.075 | Cancer | Room and water deodorants, and mothballs |
| 1,2-Dichloroethane | 0.005 | Cancer | Leaded gasoline, fumigants, paints |
| 1,1-Dichloroethylene | 0.007 | Cancer | Plastics, dyes, perfumes, paints |
| cis-1,2-Dichloroethylene | 0.07 | Liver, kidney, nervous, circulatory | Waste industrial extraction solvents |
| trans-1,2-Dichloroethylene | 0.1 | Liver, kidney, nervous, circulatory | Waste industrial extraction solvents |
| Dichloromethane | 0.005 | Cancer | Paint stripper, metal degreaser, propellant, extraction |
| 1,2-Dichloropropane | 0.005 | Liver, kidney effects; cancer | Soil fumigant; waste industrial solvents |
| Ethylbenzene | 0.7 | Liver, kidney, nervous system | Gasoline; insecticides; chemical manufacturing wastes |
| Monochlorobenzene | 0.1 | Nervous system and liver effects | Waste solvent from metal degreasing process |
| Styrene | 0.1 | Liver, nervous system damage | Plastics, rubber, resin, drug industries; landfill leachate |
| Tetrachloroethylene | 0.005 | Cancer | Improper disposal of dry cleaning and other solvents |
| Toluene | 1.0 | Liver, kidney, nervous, circulatory | Manufacturing and solvent operations, gasoline additive |
| 1,2,4-Trichlorobenzene | 0.07 | Liver, kidney damage | Herbicide production, dye carrier |
| 1,1,1-Trichloroethane | 0.2 | Liver, nervous system effects | Adhesives, aerosols, textiles, paints, inks, metal degreasers |
| 1,1,2-Trichloroethane | 0.005 | Kidney, liver, nervous system | Solvent in rubber, other organic products; chemical production wastes |

## APPENDIX 7A
## DRINKING WATER STANDARDS AND HEALTH EFFECTS
## PHOENIX ACTIVE MANAGEMENT AREA

| Contaminants | Primary MCL (mg/l)[1] | Potential Health Effects from Ingestion of Water | Sources of Contaminants in Drinking Water |
|---|---|---|---|
| Trichloroethlylene | 0.005 | Cancer | Textiles, adhesives, and metal degreasers |
| Vinly chloride | 0.002 | Cancer | May leach from PVC pipe; formed by solvent breakdown |
| Xylenes (total) | 10.0 | Liver, kidney, nervous system | By-product of gasoline refining; paints, inks, detergents |
| **Synthetic Organic Chemicals** | | | |
| Alachlor | 0.002 | Cancer | Runoff from herbicides applied to crops |
| Atrazine | 0.003 | Mammary gland tumors | Runoff from herbicides used on crops and non-cropland |
| Benzo(a)pyrene | 0.0002 | Cancer | Fossil fuels, burning organic matter, coal tar coatings, volcanics |
| Carbofuran | 0.04 | Nervous, reproductive system effects | Soil fumigant; some area restrictions apply |
| Chlordane | 0.002 | Cancer | Leaching from soil treatment for termites |
| 2,4-D | 0.07 | Liver and kidney damage | Runoff from herbicides applied to crops, rangelands, and lawns |
| Dalapon | 0.2 | Liver and kidney effects | Herbicide on orchards, crops, lawns, road/railways |
| Dibromochloropropane | 0.0002 | Cancer | soil fumigant |
| Di(2-ethylhexyl)adipate | 0.4 | Decreased body weight | Synthetic rubber, food packaging, cosmetics |
| Di(2-ethylhexyl)phthalate | 0.006 | Cancer | PVC and other plastics |
| Dinoseb | 0.007 | Thyroid, reproductive organ damage | Runoff of herbicide from crop and non-crop applications |
| Diquat | 0.02 | Liver, kidney, eye effects | Runoff of herbicide on land and aquatic weeds |
| Endothall | 0.1 | Liver, kidney, gastrointestinal | Herbicide on crops, land/aquatic weeds; rapidly degraded |
| Endrin | 0.002 | Liver, kidney, heart damage | Pesticide on insects, rodents, birds; restricted since 1980 |

## APPENDIX 7A
## DRINKING WATER STANDARDS AND HEALTH EFFECTS
## PHOENIX ACTIVE MANAGEMENT AREA

| Contaminants | Primary MCL (mg/l)[1] | Potential Health Effects from Ingestion of Water | Sources of Contaminants in Drinking Water |
|---|---|---|---|
| Ethylene dibromide | 0.00005 | Cancer | Leaded gasoline additives; leaching of soil fumigant |
| Glyphosate | 0.7 | Liver, kidney damage | Herbicide on grasses, weeds, brush |
| Heptachlor | 0.0004 | Cancer | Leaching of insecticide for termites and very few crops |
| Heptachlor epoxide | 0.0002 | Cancer | Biodegradation of heptachlor |
| Hexachlorobenzene | 0.001 | Cancer | Pesticide production waste by-product |
| Hexachlorocyclopentadiene | 0.05 | Kidney, stomach damage | Pesticide production intermediate |
| Lindane | 0.0002 | Liver, kidney, nervous, immune circulatory | Insecticide on cattle, lumber, gardens; restricted in 1983 |
| Methoxychlor | 0.04 | Growth, liver, kidney, nerve effects | Insecticide for fruits, vegetables, alfalfa, livestock, pets |
| Oxamyl (Vydate) | 0.2 | Kidney damage | Insecticide on apples, potatoes, tomatoes |
| Pentachlorophenol | 0.001 | Cancer, liver, kidney effects | Wood preservatives, herbicide, cooling tower wastes |
| Picloram | 0.5 | Kidney, liver damage | Herbicide on grass sod, some crops, aquatic algae |
| Polychlorinated biphenyls | 0.0005 | Cancer | Coolant oils from electrical transformers; plasticizers |
| Simazine | 0.004 | Cancer | Herbicide on grass sod, some crops, aquatic algae |
| 2,3,7,8-TCDD (Dioxin) | $3 \times 10^{-8}$ | Cancer | Chemical production by-product; impurity in herbicides |
| Toxaphene | 0.003 | Cancer | Insecticide on cattle, cotton, soybeans; canceled in 1982 |
| 2,4,5-TP (Silvex) | 0.05 | Liver and kidney damage | Herbicide on crops, right-of-way, golf courses; canceled in 1983 |

## APPENDIX 7A
## DRINKING WATER STANDARDS AND HEALTH EFFECTS
## PHOENIX ACTIVE MANAGEMENT AREA

| Contaminants | Primary MCL (mg/l)[1] | Potential Health Effects from Ingestion of Water | Sources of Contaminants in Drinking Water |
|---|---|---|---|
| **Radionuclides** | | | |
| Combined Radium-226 and Radium-228 | 5 pCi/l[4] | Bone Cancer | Natural deposits |
| Gross Alpha[5] | 15 pCi/l | Cancer | Decay or radionuclides in natural deposits |
| Gross beta | 4 mrem/yr[6] | Cancer | Decay of radionuclides in natural and man-made deposits |
| Radon-222 (Proposed) | 300 pCi/l | Cancer | Natural sources |
| Uranium (Proposed) | 20 µg/l[7] | Cancer | Natural sources |
| **Microbiology** | | | |
| Giardia lamblia | TT[8] | Gastroenteric disease | Human and animal fecal waste |
| Legionella | TT | Legionnaire's disease | Indigenous to natural waters; can grow in water heating systems |
| Standard Plate Count | TT | Indicates water quality, effectiveness of treatment | |
| Total Coliform | [9] | Indicates gastroenteric pathogens | Human and animal fecal waste |
| Turbidity | [9] | Interferes with disinfection, filtration | Soil runoff |
| Viruses | TT | Gastroenteric disease | Human and animal fecal waste |
| Total Trihalomethanes | 0.1 | Cancer | Drinking water chlorination by-products |

[1] mg/l = milligrams per liter (all MCLs are in mg/l unless otherwise indicated)
[2] "MFL" means million fibers per liter greater than ten microns
[3] The MCL for fluoride applies to community water systems only
[4] pCi/l = picocuries per liter (30pCi/l is equivalent to 20 µg/l)
[5] Gross particle activity, including Radium-226 but excluding Radon and Uranium
[6] mrem/yr = millirem per year, see ADEQ, Drinking Water Rules source (1) for more information
[7] µg/l = micrograms per liter
[8] Treatment Technology (refer to source (1) for more information)
[9] Refer to source (1) for more information

Sources: Arizona Department of Environmental Quality, Arizona Drinking Water Rules, April 28, 1995
United States Environmental Protection Agency, Office of Water 4304, EPA 822-B-96-002, October 1996
United States Environmental Protection Agency, National Primary Drinking Water Regulations, Appendix A: National Primary Drinking Water Standards (Modified 1/14/98)

## APPENDIX 7B
## SECONDARY DRINKING WATER STANDARDS[1]
## PHOENIX ACTIVE MANAGEMENT AREA

| Contaminants | SMCLs (mg/l)[2] |
|---|---|
| Aluminum | 0.05 to 0.2 |
| Chloride | 250 |
| Color | 15 color units |
| Copper | 1.0 |
| Corrosivity | non-corrosive |
| Fluoride | 2.0 |
| Foaming agents | 0.5 |
| Iron | 0.3 |
| Manganese | 0.05 |
| Odor | 3 threshold odor numbers |
| pH | 6.5 - 8.5 |
| Silver | 0.1 |
| Sulfate | 250 |
| Total dissolved solids | 500 |
| Zinc | 5 |

[1] Secondary Drinking Water Standards are unenforceable federal guidelines regarding taste, odor, color and certain other non-aesthetic effects of drinking water. States may adopt their own enforceable regulations governing these concerns.

[2] Secondary Maximum Contaminant Levels (SMCLs) units are in milligrams per liter (mg/l) unless otherwise indicated.

Source: United States Environment Protection Agency, Office of Water 4304, EPA 822-B-96-002, October 1996